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THE AGGREGATE REAL ESTATE MARKET

An Evaluation of Prevailing Hypotheses Explaining the Time Series Trend in United States Average Farm Real Estate Values

by

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I. INTRODUCTION

The Problem

Farm real estate accounts for approximately 75 percent of the value of all farm assets held by farm operators and landlords. Changes in its value therefore have a dramatic impact on the wealth, credit and income positions of these people. Knowledge of the factors affecting real estate prices can therefore improve our ability to evaluate the impact of various institutional and economic factors on the well being of farm operators and land owners.

Concern over the well being of farm operators and land owners has, over the last three decades, been expressed largely through our system of farm price supports and direct income payments. However, even with these payments, farm operators on the average seem to be earning low returns on the value of their assets. Data from 1940 to 1970 show that residual returns to real estate have ranged from 2 to 6 percent of market value.[56, p.65] During the same period, it has been observed that net farm income per acre has increased only modestly while land values have increased sharply. These two observations have stimulated numerous studies which attempted to explain why real estate values continued to rise in the face of seemingly low returns. However, at the national level each of the studies has tended to support different hypotheses concerning the rise in land values from 1940-1970. Although some factors were common to several studies, the method of analysis used and the interpretation of the results has differed widely. Thus, apparently conflicting views still exist concerning the primary reasons for land value increases at the national level although quite rigorous mathematical and statistical tools were applied to the development of structural equations to explain the rise in the average value of farm real estate nationally.

The continued debate over the cause of national land price increase tends to complicate the development of policies which could improve the well being of farm operators and land owners and, perhaps at the same time, improve our use of land.

Objectives

The specific objectives of this study are:

1. To review and examine alternative hypotheses concerning the cause of changes in farm real estate values.
2. To determine which hypotheses have merit in today's economic environment.
3. To evaluate the effectiveness of several econometric models in "explaining" changes in farm real estate values.
4. To develop a simplified model for predicting the average value of farm real estate.

Methodology

The basic approach will be (1) to review the literature on farm real estate and to select from this literature those variables which have had the strongest support as determinants of land value, (2) to examine each of the variables theoretically and empirically, (3) to critique the methodology of previous studies and indicate the strong and weak points of the approaches used. The empirical analysis in this thesis will vary from variable to variable and chapter to chapter as techniques are adopted which can be used with the available data. Whenever it is possible, the importance of the variable will be assessed at the national, regional and state level.

Thesis Plan

Chapter two contains a brief review of previous research on farm real estate values, classified by level of aggregation and by the approaches used in the analysis. Chapters 3 through 8 relate to specific hypotheses which have been developed to explain changes in land values. Chapter 9 contains a model developed to predict changes in the national index or in the average value of farm land in the U.S. Chapter 10 draws together the major implications and conclusions of the thesis and suggests directions for further research.

II. REVIEW OF LITERATURE

Research on farm real estate markets and farmland prices and values has historically been divided between State market studies and analysis of aggregate data for the United States. Some small amount of analysis has been done on the impact of specific institutional factors such as farm commodity programs or highway construction on land values. This chapter briefly reviews a few of the more important studies in each category. First in a general summary framework and secondly in greater detail for specific projects selected as representative of the broad category. In general the ideas of the authors will be presented without comment in this chapter. Critiques of the projects will be brought in where relevant in succeeding chapters of the thesis.

State Studies

Typically studies at the State level have attempted to determine the actual level of land values within the State, the variation in values among areas within the State, some characteristics of the participants in the real estate market and an estimate of the various factors influencing the level of real estate prices (2,7,8,9,10,12,14, 26,33).

For example, Pine and Scofield, using descriptive analysis, found that most transfers in Kansas were for farm enlargement and that "few of the tracts sold were large enough for farm units". [35] "Three fifths of the sellers were active or retired farmers and seventy percent were over 55 years old". Per acre prices were found to vary with size of tract, condition of buildings, distance to town and percent cropland in tract". Murray and Reinsel found that land prices in Maryland were related to population density and rate of growth, per capita income of the population, size of tract, presence of buildings, distance from shopping areas, type of road and presence of water front. [33] No significant relationship was found between price per acre and commuting time and commuting distance. Crowley has demonstrated the relationship between net landlord returns and land value in Oregon [8].

Numerous other studies at the State level have looked at similar variables and have found that basically the same relationships are important in determining the difference in the prices paid for specific tracts. However, attempts to quantify the impact of specific factors have been complicated by the great variation in sales prices and the small number of observations available for analysis.

National Studies

At the national level much of the research in the last decade has been developed around an observation that land values and net farm income are not changing proportionately. (1,4,6,22,23, 25,28,37,39,53, 54). These studies have generally assumed a national farm real estate market and have attempted to explain the observed divergence of trends in net income and land values using aggregate data for the United States. Several econometric models that predict the national average value of farmland have been developed.

One unique study by David Boyne looked at the impact of changes in the value of all assets, including real estate, on the wealth position of farm operators.

A model developed by Tweeten and Martin is fairly typical of recent national studies. (53) They used a 5 equation recursive model which they believe is "...designed to approach reality more nearly than some earlier specifications with a single land price equation." Beginning with the hypothesis that net income is a proxy measure for returns to farm real estate they determine that "...land earnings do not explain the land price index since 1950, therefore other variables must be important and other hypotheses must be advanced." They propose eight hypotheses which include "...1) economies of scale, 2) capitalized farm program benefits, 3) an excess number of boys who want to farm, 4) speculation or appreciation in land value, 5) population growth, 6) nonfarm investor demand, 7) changing farm financial structure and 8) a trend toward concentration of wealth among operators of large farms."

Their results show that farm enlargement is the most important explanatory variable followed by nonfarm variables and capital gains. However, they conclude:

> "The econometric model presented here is only a subset of many possible specifications of the land market. Because more than one set of variables predict land prices well and can be justified from an economic standpoint, the process of selecting the appropriate model is necessarily somewhat subjective and dependent on the judgement of the researcher".
>
> "Our results support the conclusion that there is no one uniformly best estimating procedure. The appropriate technique depends

on the reliability of data, underlying economic structure, and availability of research resources."

Herdt and Cochrane developed a 3 equation model to explain changes in the average value of farm real estate assuming, as did Martin and Tweeten, that net farm income (a proxy for land earnings) no longer provides a reasonable explanation. [22] Herdt and Cochrane state "It is our contention that technological advances have contributed significantly to the rise in farm land prices."

Technological change is represented in their model by the U.S. index of productivity and is found to be "...decisively the most important (factor) with the ratio of prices paid to prices received and the general price level of secondary importance and other variables of rather minor importance." Nonfarm factors originally included in the model were deleted because of intercorrelation with the productivity index.

Although farm price support and direct payment programs are important in the specification of the Herdt and Cochrane model, no estimate of their impact is made separate from technology.

Van Vuren, in a somewhat different analysis, found that non agricultural employment was highly significant and perhaps the most important factor explaining farm land prices. [58] Second in importance was technology represented by the total value of farm machinery.

The Van Vuren model differs from other studies because regional differences in value are assigned to dummy variables. However, this still assumes that the impact of other factors is constant across the various regions.

The three studies cited here are representative of much of the land value research at the national level and demonstrate the differences of opinion that exist among economists as to the cause of the upward trend in land values.

Herdt and Cochrane are convinced that technological change is important. Van Vuren suggests that nonfarm factors outweigh technology, and Martin and Tweeten imply that they can't really determine what has been important; but they can predict the farm real estate index with their variables.

Commodity Studies

In general, the commodity studies have focused on the effect of price support and production control programs on the value of land used for specific crops. These studies have shown that allotments do have a capitalized value and that the long term average capitalization rate is in the neighborhood of 15 percent.

For example, Gibson, Arnold and Aigner, studying flue-cured tobacco allotments, found that an acre of allotment was worth $1,673 in 1957 (13). And, depending on the size of the allotment and the available operating capital, perpetuity discount rates ranged from 5.9 percent to 24.0 percent.

In their summary they state:

> "Apparently, farmers use discount rates substantially above the normal rate of interest when they determine how much they can afford for farmland with a tobacco allotment attached."
>
> "Conceptually, one would expect farmers to capitalize land income at a rate above the normal rate of interest. First, there must be some uncertainty in the minds of farmers regarding the continuation of the price support program in its present form. Second, the land market is characterized by a great variation in characteristics of the units sold and inadequate knowledge regarding the supply-demand situation for farmland."

Gibson and Chambliss, in a study of peanut allotments, found "...that a portion of the selling price of peanut farms is paid for the right to produce and market peanuts; that is, the size of the allotment is a factor considered by buyers in determining the price they are willing to pay for a farm" [4] In this study the authors found capitalization rates of 14.2 to 20.2 percent in perpetuity, depending on the size of the farm and the size of the allotment.

Gilliam, in a study of the valuation of cotton producing land, used regression analysis to determine the capitalized value of an acre of cotton allotment [5]. However, he concludes his thesis by suggesting that it is extremely difficult to avoid unmanageable intercorrelation among some of the relevant independent variables. He suggests that single equation regression models may be inappropriate or inadequate and expresses a concern over simultaneous equation models which assume that price and quantity are jointly determined. Even with his doubts concerning the application of certain econometric techniques, Gilliam does conclude that cotton program benefits have been capitalized into land values and that tracts purchased for farm enlargement sold for more per acre than other comparable tracts, other things equal.

Other commodity studies have produced results similar to those mentioned in this section. That is, they have found that farm program benefits have been capitalized into land values and that the implied capitalization rates are considerably higher than the market rate of interest. These studies have not, in general, attempted to arrive at an estimate of the aggregate impact of programs or the capitalized value of the aggregate benefits.

Selection of Hypotheses for Consideration

Two criteria were used to select the hypotheses to be explored in this thesis. First consideration was given to those which have received support in previous studies and secondly, those without much empirical support, but with a general acceptance by economists or the popular press as being important over broad geographic areas.

No consideration will be given in this manuscript to the cross-sectional impact of land quality, variations in crop production, locality or other factors which set differences in levels of land values among areas but which are not expected to be important in explaining changes in land values over time.

The hypotheses selected for consideration are:

1. Capital appreciation has caused expectations of continued capital appreciation, therefore prices include this source of income as a basis for value.
2. Increasing farm enlargement demand for farm land has caused farm real estate price increases.
3. Government income and price support program benefits have been capitalized into land values, increasing real estate prices.
4. Nonfarm demand for land (urbanization) has caused farm real estate price increases.
5. Technological change has shifted basic relative relationships among inputs causing farm real estate price increases.
6. Seller financing has increased the demand for real estate, therefore prices have risen.

7. Increases in population have resulted in a shift in the demand for farm land causing a rise in farm land prices.

8. Inflation in the general economy has caused a rise in real estate prices.

In the following chapters each of these hypotheses will be examined in some detail.

III. CAPITAL APPRECIATION AND LAND PRICES

In the last decade many economists and journalists have accepted the hypothesis that expectations of continued appreciation in land values were important in the pricing decisions of farm real estate buyers. References to appreciation or capital gains appeared with increasing frequency in the literature on land values and since the late 1950's appreciation in the value of capital assets (land) has been recognized as part of the income stream of land owners [4,6,17, 19,22,23,30,38].

A common argument, used to support the inclusion of capital gains in the land equation, is that rates of return on the average market value of farm real estate appear to be very low in relation to alternative investment opportunities. It has been suggested by many that the low average rate of return from annual income must be supplemented with the annual appreciation in land values to arrive at the appropriate rate of earnings for land. This approach begs the question, "What causes appreciation?". It assumes that appreciation is either determined exogenously to price or that prices can be explained by a circular system which would lead to an increasing upward or downward spiral.

This chapter is focused on the possible relevance of appreciation in land values as a factor explaining farmland price behavior. To simplify the discussion, only increases in value will be considered or examined in this chapter. However, the possibility of decreases in values is also implied.

Appreciation and Price

Appreciation is defined as an increase in the value of an asset caused by price changes. In the aggregate, total appreciation is equal to the change in price times the physical quantity of the asset.

Because appreciation and an increase in price are identical, a model which explains the causes of price increases explains the causes of appreciation. Therefore, those factors which shift the supply of an asset or the demand for it affect appreciation.

In a world of certainty, the price of an asset is based on the income stream that the asset will produce over time or on the satisfaction that the holder of the asset receives. In a world of uncertainty, the price of an asset is based on the expected income stream and the degree of uncertainty associated with the income stream. If we know with certainty that the future income stream is unchanging and discount rates are constant over time, the price of the asset will not change. However, if we anticipate changes in the income stream, changing interest rates or continued increases in the general price level, the nominal price and perhaps the real value of the asset will change.

It has been suggested by some economists and the popular press that farmers buy land with the expectation of low returns from farm production but with an expectation of additional return from capital appreciation, because land values are rising. However, if rising prices cannot be justified by increasing returns from some expected productive use, (either from farm or non-farm) or from inflation, the expectations of continued price increases cannot be justified by capital gains.

Appreciation as Income

There are those who would argue that capital appreciation is, in fact, income [4,22,23,38]. Others, recognizing appreciation as income, argue that appreciation should be part of the explanatory equation for the price of the asset. Certainly capital gains (realized appreciation) are recognized as income by the Internal Revenue Service and receive special attention under tax regulations. However, in any one year only 3 to 4 percent of the land owners actually receive capital gains income by selling their property. The income thus received is generally not the result of 1 years change in price, but the accumulated effect of price changes over a period of several years. Thus, capital gains are not identical with current appreciation.

Appreciation is an increase in the monetary value of an asset, just as capital gains are an increment to income. They both result from the collective actions of buyer and sellers, who formulate new expectation of the income stream from an asset over time. If the correct estimate of the income stream could be determined with certainty, and there was no change in discount rates, prices would increase only as income increased. In a world of uncertainty, appreciation occurs because of errors made in projecting the income stream. The greater the certainty of the income stream, the lower the likelihood of gains or losses; and the greater the uncertainty, the higher the possibility of error, thus gains or losses in value are more likely. Appreciation, therefore, seems to be more a return to risk and uncertainty than a return to land. In a world of uncertainty, appreciation seems to occur because of the difference between the expected income stream and the actual income stream.

Inflation in the general economy can also be a cause of land value appreciation. That is, as the money supply increases relative to the quantity of goods and services or the velocity of money increases, prices will rise as money incomes increase and economic units attempt to buy consumption goods and services or the use of resources. If all prices and incomes rose at the same rate, which they don't, no change in the real value of assets would occur and this form of inflation would be unimportant. However, inflation causes an adjustment of the relative value of monetary and real assets. Factors that cannot be increased in supply are affected more than other inputs or consumption goods. Thus, one would expect land prices to rise more rapidly than the general price level in a period of inflation. That this does not always hold is proven by our experience since 1968. Consumer prices have risen more rapidly than land values; however, this appears to be the result of selective inflation controls which had a greater impact on long term investment decisions than on consumer prices.

Speculation As A Factor In Real Estate Prices

The appreciation hypothesis has probably gained much support from those who view speculation as an important factor in the farm real estate market. Certainly speculation is important in those areas where a change in land use is impending. In such areas land prices can change rapidly in a very short time period until land in the area is valued for the new use. However, in areas where use changes are not expected or where they are some distance away in time, speculation would seem to play a rather insignificant role.

Comparisons have been made, by Scofield and others, of the market for common stocks and the market for real estate. [44] Many similarities do in fact exist. Yet the differences are great and applying inferences from one to the other seems somewhat dangerous to say the least. One of the major differences is that the market for common stocks is highly volatile while real estate markets are rather stable. A stock selling at one price today may be up or down by 5 percent or more tomorrow. Speculators move into and out of the stock market quickly and are able to accumulate or liquidate holdings with minute to minute changes in the price of the stock. Speculators take long or short position on the expectation of a change in price of a stock, and such price changes are not necessarily related to the expected earnings of the company. The major concern of the speculator is in short term changes in value rather than in actual earnings from production. The speculator thus derives most of his income from gains acquired rather than through the return to capital as a factor of production. The speculator in fact makes his return by capitalizing on the judgement errors of others. The stock market investor may take a different approach in the market by buying stocks with favorable returns from production where the company has shown favorable earnings over a long time span. The investor, therefore, bases the price at which he is willing to buy the stock largely on his expected annual return and the relative certainty of a return. If he is correct in expectations, he has secured a favorable stream of income and hedged the value of his assets against inflation.

The real estate investor and the stock market investor have many attributes in common. However, the stock market speculator and the real estate speculator seem much farther apart.

The real estate speculator gambles only on a "long" position; he cannot take a short position and sell land that he doesn't own. He must gamble that a shift in land use will occur which will allow prices of specific tracts to rise faster than the rate of inflation and at a rate that will also cover his holding costs. Because of transactions costs, he cannot move into and out of the real estate market easily; and, therefore, is committed to the market for a relatively long period except under very special circumstances. Most land speculation, therefore, is confined to areas that are undergoing rapid use changes which offer the possibility of sharp changes in price.

It seems unlikely that the typical farmland owner could afford to gamble on appreciation. In general, his supply of capital is limited; and he must rely on annual earnings to provide a livelihood for himself and his family. If income from appreciation is entered into his pricing decision, it is so remote that it is heavily discounted. For example, a net return of $100.00, 30 years from now at a capitalization rate of 7 percent would be worth $13.13 discounted to the present. However, if we account for inflation and a high preference for present income by increasing our discount rate to 15 percent, we would pay only $1.50 for $100 net gains in 30 years.

If we expect appreciation of 5 percent per year, land priced at $100 today would be worth $432 in 30 years. The gross appreciation would be $332. However, as much as 25 to 35 percent of this could be removed through taxes leaving $215 to $250 after taxes.

Thus, the land buyer with a fairly high preference for current income (a 15 percent discount rate) might pay $3.00 to $3.75 more per hundred dollars of value if he expects continued inflation of 5 percent per year over 30 years. This would seem to be fairly typical of the expectation of farmers in many of the more rural areas of the country where land use is not changing rapidly. In the more urban areas, price increases for farmland may be much more rapid (10 percent or more); and the buyer may be fairly certain that land will be sold for a "higher use" in 5 to 10 years. In such an urban environment a discount rate much closer to the market rate of interest might be used. It seems unlikely that the effect of appreciation is evenly distributed across all land because the reasons for land price increases vary among real estate markets. In the more rural areas, price changes are much more likely to be supported by changes in agricultural income. In urbanizing areas the source of price increase is more nearly supported by the shifts that occur in land use.

Empirical Applications of Appreciation

Two studies, one by Reynolds and one by Tweeten and Nelson [38,54], have attempted to use "capital gains" (appreciation) in econometric models explaining land prices. In the first study, Reynolds included capital gains (appreciation) in land values in their model by using the first difference of the price time series deflated by the index of prices paid by farmers (38, p.388). This appears to be somewhat of a hybrid variable. They seem to be trying to arrive at a variable adjusted for inflation or the change in relative price of goods and services. However, the deflator should be applied to the entire time series before taking the first difference rather than applying the deflator to the difference. For example, if land values in any 2 successive years are \$187 and \$194 and the deflator index was 100 and 104 for the respective years, Reynold's computation would show:

$$\$194 - \$187 = \$7 \text{ and } \$7 \div 1.04 = \$6.73$$

However, the true deflated change should be:

$$\$194 \div 1.04 = \$186.53 \text{ and } \$186.53 - 187 = -\$.47$$

Each dollar of value is affected by the deflation process, not just the change in value. It would seem, therefore, that any coefficient associated with this "appreciation" variable would be useless; and the "true" effect cannot be determined.

Tweeten and Nelson also include a variable called "capital gains" in their model of the "national real estate market". "Capital gains in year t are computed as the increment in (total) real estate value for the 48 States from March 1 year t to March 1, year t+1; less capital improvements, and deflated by the index of prices paid by farmers for items used in family living, 1957-59=100." (41, P.7)

It appears that they have fallen into the same statistical trap as Reynolds and Timmonds. First, they have not adjusted for the change in land in farms. Second, there is no series that reflects capital investment in real estate properly, and third, they have deflated only the increment to value in current prices by the FFLI (Farm Family Living Index). Yet, the change in the FFLI would be reflected over the value of every dollar, not just the additional dollars. However, they conclude that "capital gains" is responsible for 9 percent of the change in land prices from 1950 to 1961. In a formulation that does not include land retirement but covers the period from 1950-1963, they find that appreciation is responsible for 17 percent of the price change.

An additional problem is that the term "capital gains", as used in the two projects just discussed, is misleading. Capital gains, as used in this chapter and as generally accepted by economists, refers to realized appreciation. Thus, only a small percentage of land owners receive capital gains in any one year. Capital gains are not synonymous with appreciation as the above studies imply.

It appears that the authors of both studies were trying to develop a measure of the real gain in land values (the change in real wealth) from appreciation; however, they did not succeed.

Conclusions

The major conclusions that can be drawn from this chapter are that changes in the price of land (appreciation) in those areas where a change in use is unlikely will have very little effect on the price paid for land. However, in areas where a change from farm to nonfarm use is likely to occur in a fairly short time, the possibility of receiving capital gains may be very important in the pricing decision.

In addition, attempts to include capital appreciation in econometric models explaining the average value of farm real estate have produced misleading results.

It seems that we have been led to a rather naive expectations model based on previous price increases because of the complexity of the land market and the imperfections in the data available for analysis. However, such a model is unsatisfactory because it hides the true cause of land price changes.

CHAPTER IV

TECHNOLOGICAL CHANGE AND LAND PRICES

Almost all national studies and many State and regional studies of farm real estate prices since 1960 have assumed that technological change occurring in agriculture has had a positive effect on farm land prices. Two in particular have suggested that technological change has been the most important factor influencing land values since the 1930's [6,22]. Both studies, however, rely heavily on the presence of farm price support programs to support their analysis.

In this chapter the analysis will be focused on the effects of technology in the absence of farm programs and on the problems of isolating technology as a variable in a model of the land market. The effect of farm programs has been given more detailed analysis elsewhere in this manuscript. However, the effect of programs and farm enlargement is discussed briefly in this chapter to show the possible interactions with technology.

Technology and Economic Theory

In static economic analysis technology like the tastes and preferences of individuals and the population are assumed constant while prices and quantities are allowed to vary so we can determine the "pure" price and quantity effects on the various resource and output combinations.

When we allow technology to change, we lose precision in the measurement of quantity and price effects and cannot interpret the results under the usual (other things equal) conditions of marginal analysis. Because technological change is extra marginal, its effects are lost in the usual theoretical analysis.

Webster defines technology as "the totality of the means employed to provide objects necessary for human sustenance and comfort". This implies that technology is inclusive of all information about the production process and all production relationships as represent the current state of the arts with respect to production and distribution relationships.

Technological change is defined as a shift of the relationships in the production process and distribution process that result from the introduction of new machines, new varieties of seed or different production systems.

Technological changes occurring outside the industry may also be important because of their impact on the price of farm inputs or on the price of substitutes for farm output. These changes will be discussed later in the chapter.

In the aggregate, technological change occurs when one firm adopts a different production system. For the firm, technological change occurs when it adopts a different production system. In a world of imperfect knowledge and uncertainty, the distinction between the aggregate and the firm seems important. New technology can be developed but not incorporated in the production process by individual firms because of lack of information, personal preference, or deliberate action may occur because the technology is cost increasing to the firm or because the use of the specific technology has social consequences that go beyond the internal benefits to the firm and are regulated by society.

A change in technology under Webster's definition results in a change in our n-space production surface, and the new surface need not bear any fixed relationship to the previous surface.

Technological Change in Competitive Markets

Within purely competitive markets for output and inputs using a factor-product model, we can show a change in technology by a simple shift in the production function. As a result of the change in the function, the cost curves associated with a function also change.

If, in fact, these changes occur, what is the likely impact on the demand for, and supply of, farmland and, therefore, on the price and value of land?

First, any technological change which increases the marginal product of a factor will shift the demand curve for that factor to the right increasing the quantity demanded at any price of the factor; thus, firms will attempt to use more of the factor and the price of the factor will rise, although each firm operates as if the supply of the factor were perfectly elastic. At the same time, the price of the product will fall as firms attempt to sell their increased product on the market. The net result will be that more output will be forthcoming at a lower price to consumers.

However, because of imperfect knowledge and imperfect markets for inputs, not all producers or all potential producers adopt the new technology at the same rate. Thus, some firms gain the advantage of higher returns over a considerable time period; while other firms are continuing to produce with outdated technology. Eventually firms using the old technology must either adopt the new technology or be forced out of production as average revenue (price) falls below their average variable cost curve.

Under competitive situations the "benefits" of technology should be passed onto the ultimate consumer of the product in the form of lower prices. The introduction of new technology should then not affect relative factor earnings if the technological change is neutral. If the change is not neutral, with respect to all factors of production, a shift in the marginal product of one factor with respect to other factors will result. Thus, the relative prices of inputs will change, resulting in the increased use of one and the decreased use of another, so long as the inputs are substitutes.

Because the originator of an idea cannot exercise monopoly control except in the case of patents and copyrights, and because a change in technology shifts the production surface, the benefits and cost of changing technology are "extra marginal". In many cases technological change results in non pareto better adjustments for non adoptors because the value of their productive assets declines as these assets are made obsolete by the new technology. A prime example of this is in farm buildings. In the early part of this century, buildings were typically constructed with a life span of 50 to 75 years and were developed for the technology of the period. Over the last 60 years, the value of the capital stock declined because it was unsuited to the newer, everchanging technology. As technological change has become more rapid, the planning horizon has shortened; so that the life of capital investments is reduced. Thus, the real value of the building stock has declined in relation to the value of land. Old buildings have not been replaced or, if they have been, new buildings are constructed with a much shorter useful life.

Another example of technological change which could result in differing benefits might be the introduction of a new machine that allows an individual to spread his labor over more acres because of the increased machine capacity. However, such machines may not be suited to use in some of the more hilly land areas of the county; and farms in these areas must produce with a more labor intensive technology. Thus, they are placed at a greater disadvantage than before in competing with producers on level land.

Regional Impact of Technology

The foregoing digression points out that technology can have detrimental as well as beneficial effects and that these effects are not always borne by the same individuals, thus technological change brings about a shift in the wealth and income distribution.

For example, a change in technology which allows feed grain production to enter dryland areas, that were formerly grazing land, can cause a decline in value of land in the Corn Belt and an increase in land value in the new area. This could occur because feed grains are substitutes for corn and an increased supply of other feed grains would cause corn prices to fall and lower income could result in the Corn Belt, while incomes increased in the new feed grain area. Another example of the impact of technology which could be non pareto better would be the development of a grass variety that would allow doubling of beef cattle on western grazing land. Certainly this would make it less desirable for the south to enter beef cattle production. Also, the development of broiler and egg production technology made several hundred thousand layer houses and brooder coops obsolete within a few years.

The major point to be made here is that the impact of technological change has not been the same across the nation because technological change tends to be input specific or commodity specific.

Effect of Non-Farm Technological Change

The effect of technology reaches agriculture from beyond the change occurring inside the farm firm--a new synthetic material, milk substitutes and petroleum protein all enter into the cost-price relationship of agriculture. In addition, the extension of electrical power and paved highways to rural areas has done much to change the competitiveness of rural areas and the desirability of rural areas as places to live. It would seem, therefore, that any measure of technology must include the impact of such factors.

Empirical Measures of Technology and Technological Change

Several economists have argued persuasively that technological change has had a positive impact on the value of farmland. [6,22,38] That is, the benefits of technology have been capitalized into the value of land instead of being passed on to the consumer of farm products or retained as a return to labor or other nonland factors. It has been argued that technological change, in combination with farm price support programs, has resulted in greater profits for the firm and that the continuation of such profits, because of the price floors for commodities, has caused farm land operators to bid up the price of real estate. For example, Chryst argued that "The increased output and/or decreased unit cost (resulting from a change in technology) without comparable decreases in product prices accrue as income to fixed factors. For individual farms, both land and family labor may be fixed for particular production periods. [5, p.1270]" Chryst further argued that family labor is fixed to a greater extent than land and that land becomes the primary variable in firm expansion capturing the benefits of the joint effect of technological change and price support programs.

Herdt and Cochrane, defining technological advance as "the capability of the firm to produce a greater amount of output for every unit of input that it commits to the production process", reached basically the same conclusions as Chryst. Farm programs and technological change when combined have resulted in increases in land prices. [19]

In both of the above studies, it is assumed either explicitly or implicitly that the effects of technological change have been uniform across all land and that the same technology can be readily adopted in all areas. In addition, all agricultural products are assumed to have a price floor established by farm programs. Also, nonfarm technological change is ignored; and finally, the impact of rising prices for other inputs is not considered. That is, the net impact of new technology may have been to hold cost curves constant for the adopting producers while non adoptors find costs rising.

I have argued, earlier in this chapter, that technological change is input and commodity specific and that nonfarm technology has a strong bearing on the farm sector. Also input prices in general have risen rapidly and much of the new technology is introduced to hold the line on cost rather than to reduce them below previous cost levels. The evidence does not suggest that the net income to farm production has been rising or that technological change has resulted in increased net return to land.

Proxy Measures of Technological Change

Herdt and Cochrane assumed that the USDA productivity index was a suitable proxy for the impact of technology and, because they define technological change as an increase in output per unit of input, this seems as though it has much to recommend it. [22] However, the concept of the productivity index is somewhat complicated. The index itself is the quotient of the index of farm output which measures the change in the physical volume of output in base period prices and the index of farm inputs also measured in physical terms in base period prices. The quotient of these two indexes indicates how one index changed relative to the other from year to year. The index of inputs is based on the total inputs committed to agriculture and not on the inputs actually used; thus, fixed inputs, although idle, enter the divisor. Also, labor is entered into the equation at constant wage rates. This may place a lower value on labor in the production process than would be found as the contribution of labor to production because wages increase in terms of current dollars and this changes the quantity used. Also changes in current prices affect the quantities of other inputs used and these changes may be reflected in the input index as an increase in inputs used even though the total cost of using the increased volume of inputs may have declined because of the change in the current market price.

Also the index series used by Herdt and Cochrane did not show the impact of technology that changed the relative advantage of one region to another in the production process nor did it truly show the cost effectiveness of any technological change. Since the Herdt and Cochrane model was developed, indexes have been prepared that show the changes in "productivity" by regions.

An additional problem is that use of any data series as a proxy for technology implies that some cardinal measure of technology and of technological change is possible because a proxy must be assumed to parallel the trend in the variable it represents. Therefore, a larger number on the productivity index implies a higher level of technology (more technology). Whether or not such a measure of technology is possible is open to question. However, casual observation of the land value series and the productivity index would show that they have both increased since the early 1930's; and, therefore, they would be positively correlated. The fact that a positive correlation exists does not imply any casual relationship nor does it measure the impact of technological change.

An additional problem with the Herdt and Cochrane model is the high degree of correlation between the productivity index and their urban influence variable. The correlation coefficient for the productivity index and their urban land variable is .98. Both have a strong upward trend and the urban land variable consisted of census year observations and linear interpolation between census periods.

Feeling that the productivity index was the strongest variable and wanting to reduce intercorrelation among the independent variables, Herdt and Cochrane deleted the urban variable from the model. Although this removes the effects of intercorrelation, the remaining variable now is assumed to contain both effects. It is, therefore, impossible to separate the influence of the two or determine which has the greater impact. This is not a real problem in a predictive model; but if we are trying to make inferences about the structure of the market, we should not rely on the combined variable to provide an explanation. However, Herdt and Cochrane ignore this problem and title their article "Farm Land Prices and Farm Technological Advance". Given the data they used, the title might well have been "Farm Land

Prices and Urbanization". Although they do not entirely ignore urbanization in their conclusions, they relegate it to a parenthetical statement as follows:

"The evidence, both theoretical and empirical, indicates that the expectation of rising income from technological advance in conjunction with supported farm prices (and from increasing urban demands as well) has been important in contributing to the rise in farmland prices." [22, p.262]

Such a statement is hardly justified from the data or the theory. They might have said more truthfully that the data show a positive relationship exists between the productivity index and farm land prices. However, because the index is assumed to include both physical productivity increases and urbanization, it was not possible to infer what the separate relationships were. Thus, the analysis is inconclusive.

In addition, although the authors recognize that price support and direct payments to farmers have been important in determining the income stream to all residual claimants, they do not specifically introduce them in the model nor do they introduce an estimate of the returns to real estate from farm production. Thus it is not clear where the impact of these variables are picked up within their equation. Their model, therefore, does little to separate the structural components of the land market or to present information that can be used to support or refute specific policy decisions concerning farm real estate.

Reynolds used hours of labor per acre as a proxy for technology and state that, "since technology has tended to be labor saving a decrease in labor reflects an increase in technology". [38]

[38, p.338] They assume that an increase in technology is consistent with the decline in the number of farms transferred in their land supply equation.

Again, whether or not a change in technology can be interpreted as an increase in technology is yet to be determined. It seems that Reynolds and Timmonds are infering that all of the decline in labor per acre is a result of increased capital, and that all changes in technology are associated with an increase in capital relative to labor. This ignores the possibility of substitution occurring between capital and labor, or land and labor, because of changes in relative prices. As with the productivity index, hours of labor per acre does not incorporate changes that are outside of agriculture nor the regionally offsetting impact of technology on farm earnings and land prices.

Reynolds,

> selected 3 proxies for technology; hours of labor per acre, capital per hour of labor and the value of machinery per acre of farmland. [38] He was unable to use his proxies for technology in his land price equation because of a high degree of intercorrelation with other independent variables. However, he concludes his thesis by saying "The following variables have a significant positive effect on the value of farmland: expected net farm income, government payments for land diversion, conservation payments, expected capital gains, farm enlargement, nonfarm population density, technological

advance and the ratio of debt to equity". [38 p.154]

Although technology was not specifically included in the price equation, technological change was found to have a positive effect. The fact that labor per acre appears in the land supply equation does not do much to clarify the role of technology in the formation of land values. It is not surprising that labor use per acre and the number of farm transfers are positively correlated over time since both variables have shown a downward trend. However, to conclude that one or the other is a causal variable or represents a causal variable in a land price or supply equation seems to stretch the data further than warranted. Did labor decline because farms transferred or did farms transfer because of a shortage of labor?

Two studies have discussed the impact of technology on land values but have not explicitly included technology in their model. [46,47] However, they infer that the net macro effect of technological change on land prices would have been negative.

Conclusions

The empirical evidence available on technological change thus seems less than conclusive with respect to land values. Undoubtedly, technological change has had dramatic impact on the structure of agriculture. However, the net effect on factor prices cannot be isolated from other changes in the economy. Static analysis seems to show that output increasing and cost reducing technology should result in lower input prices. On the other hand, given an elastic aggregate demand, input prices could increase, remain the same or decrease.

I will not attempt a quantification of technology or of technological change in this thesis. First, because I believe it is impossible given the current state of our data and our knowledge of the various interactions that are evident in the land market; and second, even if we could quantify the impact of technology in general, I doubt that we would find much use for our added knowledge. The question is largely irrelevant at the micro level and is not subject to any policy consideration at the macro level that could be applied in an equitable manner to control land prices.

I suspect, but cannot prove, that what we view as farm enlargement demand is largely a result of changes in technology which shift the optimum size of unit.

CHAPTER V

FARM PROGRAMS AND LAND PRICES

It is often hypothesised and is generally accepted that income benefits from government price support and production control programs have been capitalized into land prices and that these programs contributed to the steady increase in land values between 1940 and 1970. Numerous studies have sought to measure the impact of such programs at both the firm and aggregate levels (1,3,5,13,14,15,38). The questions to be addressed here are: To what extent is this hypothesis justified by economic theory and where has the impact, if any, of federal programs been most important?

Farm Programs and Competitive Markets

Assume a competitive market situation in equilibrium with firms earning zero profits and with the marginal value product equal to the marginal factor cost or with long run average cost equal to average revenue. The firm is faced with a very elastic demand curve although the demand curve for the industry is quite inelastic.

Now let us assume that the government attempts to raise net income to the firm by supporting the price of the product above the free market price. To do this the government purchases some amount of the commodity. This in effect means that the industry demand curve becomes very elastic at the price support level at least to the extent that the federal budget can consume the additional production that will be forthcoming. In the short run, firms will expand output moving along their marginal cost curve. However, this causes profits to be earned. With no barriers to entry, new firms will attempt to enter the market bidding up the price of those resources with an inelastic supply so that the average cost curve of the individual firm increases.

This will continue until enough firms have entered the industry to bid the price of inputs up until long run average cost are again equated with the average revenue. Assuming a low degree of substitution between inputs, if the supply of one of the factors is more inelastic than the others, it will increase in price more rapidly and more of the added income will be allocated to this factor. On the other hand, if we could assume that all factors had equal elasticity of supply and would be used in the same proportion in the new situation, all factors would share equally in the benefits of the program. However, the more likely case is that the supply of land is more inelastic than the supply of labor, capital, or management. And land is, therefore, a more limiting factor in expansion than any of the other inputs. If there is a strong possibility of shifting from the production of other commodities to the supported commodity, the potential supply of land becomes much more elastic. With the guaranteed price, some of the risk is removed thus increasing the aggregate supply and allowing more production to enter the government grainaries. The benefits from the production under this program go to the holders of the assets used for production. The extent to which each benefits is determined by the elasticity of supply of the particular resource.

In order to avoid acquiring a large stockpile of various commodities, several methods of production control have been attempted. Most of these methods have limited the quantity of land that could be used for production. The immediate effect of this is to make the supply of land for expansion totally inelastic and to create some under-employment for labor and capital. Thus, land becomes the most limiting factor in the production process.

New entrants to the market or buyers expanding their operations find that the MVP of land has risen relative to the MVP of labor and capital. Where the quantity of land to be used in production is restricted to a smaller amount than previously employed and where the alternatives to production of controlled crops are limited, land prices will tend to increase.

If, in addition, the salvage value of labor and machinery are very low, farmers will bid up the price of the limiting factor and capitalize some of the additional income from the program into the price of land. If the difference between the marginal value product of labor and its salvage value is small, labor will more quickly turn to alternative production or to nonfarm employment; and the returns from production control programs will be more evenly distributed between the various factors. Under diversion programs, land prices will rise to the extent that diversion payments exceed the return to production in the free market and to the extent that the opportunity (salvage) value of labor is very low.

If the production control program restricts production to tracts with an allotment, then the benefits of higher prices tend to be capitalized into the value of land that has allotment associated with it. Land without allotment or without production rights tends to decline in value to the level supported by the next best crop. In any case, once the program is instituted and a different level of value established for land with and without allotment no further adjustment in value would be expected in the absence of other changes in the economy.

If production control programs worked in a competitive market and immediate adjustments were possible, an absolute limit on the quantity of land should raise the MVP of land. In the absence of substitution and with good nonfarm opportunities, labor and capital would be expected to flow out of agriculture to nonfarm employment. However, this adjustment has been rather slow because of the low salvage value of labor and capital committed to agriculture and because of the possibility of substituting capital for land.

The effect of programs has been to introduce a new variable into the production process, the historical production base of the controlled crop. Therefore, the production function changes since the acreage of historical base acts as a constraint on the use of lands. If land is the limiting factor, firms will attempt to acquire a larger base or, if they cannot, they will reorganize their other inputs to maximize returns from present holdings. So long as the

MVP of additional allotment is above its acquisition cost and the MVP of labor and capital remain between acquisition cost and salvage value, the firm will attempt to acquire more land and/or more allotment. The price of land will rise and, as additional land is added, the MVP of labor and capital increases.

The above argument can support the hypothesis of higher land values under government programs that attempt to restrict production by limiting the land resource. It is unnecessary to tie in technological change with this explanation. However, if technological change is shifting the cost curves downward, land prices might be expected to rise more than under a constant technology. The increase in land values, however, is the result of limitations placed on the quantity of land rather than through a positive correlation between technology and land prices.

The net effect of programs directed at limiting the land resource may be greater in areas where there are few alternative uses for labor and farm capital and where the next best crop has a value greatly below the value of the controlled commodity.

The commodity programs are, in fact, a two-edged sword. Land without a historical production base in the commodity can no longer be brought into production; thus, its value falls relative to the value of land with a historical base. This may not be too severe, however, because land suitable for the production of a high income crop would be expected to have such a base.

It should be possible to demonstrate that the Midwest, the Plain States, and the South have felt most of the impact of Federal programs because of the production patterns of the controlled commodities; tobacco, cotton, rice, sugar, wheat, corn and feed grains. Also, the alternatives to production of these crops are somewhat limited; and the nonfarm opportunities for labor are not very good.

Farm programs are not likely to affect land prices as much in the Lake States or the Northeast because of opportunities for nonfarm employment and the relative difficulty of combining farm operations into larger units. Also, these areas are less dependent on supported crops for their income.

A model of the land market in certain areas of the Delta States or California may show that land prices are greatly influenced by the cotton and feed grain programs. However, in the Northeast or Mountain States, one would not expect farm program payments to be significant. Thus, a national model explaining real estate prices that assumed that the effects of farm programs were the same across regions would be a misspecification. Separate models for micro-markets might show a dramatically different impact of programs in the local markets.

Empirical Evidence

Several studies have shown that production allotments in fact have a capitalized value and that these values are part of the price paid for farm property. [3,5,13,15,21,31] For example, Gilliam has shown that an additional pound of historical tobacco production per acre contributed $1.81 to the per acre price of tracts with both cotton and tobacco acreage. [15] He estimated the total value of an acre of tobacco allotment at $3,137 per acre.

In an earlier study Gibson, Arnold and Aigner found that, if tobacco allotment benefits were capitalized in perpetuity, discount rates of 5.9 to 24.0 percent were necessary to make the discounted value of the income stream equal to the market value of the allotment per acre. [13] Similar discount rates were found by Gibson and Chambliss in a study of the value of peanut allotments. [14] In both studies, the most frequently reported figures were around 15 percent.

In a national study Herdt and Cochrane have demonstrated that farm programs in conjunction with technological change can result in higher prices for farm land. [22] Using the USDA productivity index as an indicator of technological change, they show that technology has been the most important factor in changing land values from 1910 to 1960.

These studies and others like them give strong support for the idea that farm land values do include the capitalized value of program payments made to farmers. They do not show, however, the effect of programs over time, the variation in impact among areas or the total capitalized value of program payments.

Charles Schultz, discussing the impact of government subsidies to agriculture on land values, states; 1/

> "Indeed, at the limit, a subsidy attached to land eventually ends up granting no benefits to farmers. To the extent that the value of the subsidy is capitalized into land prices, the higher carrying costs soak up the annual subsidy, as land gradually changes hands over the years. But since subsidy values are frozen into the price of land, any attempt to reduce or remove them would leave recent purchasers of land with incomes below what they would have been before the subsidy program started and confront them with a capital loss. Paradoxically, therefore, after a number of years have passed, such programs end up transferring little net income to the second generation of recipients, but at the same time become so frozen into asset values that their removal would bring substantial hardship."

Schultze"s statement implies (1) that government program benefits are capitalized in perpetuity (2) that benefits are lost because of the capitalization process and (3) that removal of program benefits must cause a capital loss for land owners. As such, he fairly summarizes much of the conventional wisdom surrounding land values and farm programs.

I will argue that all three of these implications are in fact misleading and that they overstate the consequences of withdrawal from farm price support and direct payment programs.

First, it seems unlikely that benefits are capitalized into the value of land in perpetuity (as assumed by Gibson [13]) at a constant discount rate over time. Land buyers viewing the stream of income from such programs have relative certainty that programs will continue over the next 3 years (programs throughout the sixties have been written for this period), but face some uncertainty about the actual level of payments. As we look farther into the future, the

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1/ Schultze, Charles L., The Distribution of Farm Subsidies, Who Gets the Benefits? Bookings Institution, Washington, D.C., 1971 p.3.

certainty of continuation and the actual level of payment is reduced; thus, it seems, therefore, that the time horizon for capitalization might be fairly short and that the discount rate would increase as we get closer to the end of the planning period. For example, the time horizon might be 15 years or less, and the discount rate might be near the market rate of interest in the early years and increase to 18 to 20 percent or higher near the end of the planning horizon.

Secondly, capitalization of direct income benefits into land values does not mean that benefits are lost or that they accrue only to the original owner. The original owner does receive a windfall gain from the free acquisition of an additional income stream and can sell the rights to the stream of income. However, the buyer does not lose all the income. He earns a return on his investment and assuming he has used the proper discount rate the return is at least equal to his other investment returns. If land prices rise over time because of the capitalization of government payments, we can assume that original sellers did not properly evaluate the stream of income and that buyers were able to secure the stream of income under favorable conditions. That is, payments continued for a longer period than anticipated by the seller or were at a higher level. Otherwise, there would be a one-time shift in value and any other increases in the value of real estate would be the result of the influence of factors other than government payments. Additionally, there seems to be a lag in the capitalization process, but once the benefits are known, the capitalized program payments would not cause an upward pressure on value.

The third implication, that land owners must sustain a capital loss if program payments are removed, is true only if programs are expected to continue and they are in fact eliminated in a relatively short time period. If the termination date for programs is set far enough in the future--10 to 15 years--the decline in value of land would not represent a large loss to the owner of real estate unless he capitalized the value over a longer time horizon.

It should be noted, however, that to acquire the right to use land the buyer must pay for the capitalized value of the farm program payments. He, therefore, is required to use scarce capital in a manner that prevents the optimum allocation of funds. This may result in severe problems for those who are short of capital.

Alternative Capitalization Models

Capitalization assumes that buyers of an asset have evaluated the stream of earnings that will accrue to an asset over time and that they will pay no more than the expected value of this income stream discounted to the present. Buyers are also assumed to partition returns among factors of production.

Land buyers, in any year, would, therefore, estimate the expected income flow from land and discount to a present value. This income flow might include a factor for satisfaction or a factor for the capital gains income received in the last year of ownership as well as production income. If the income flow is expected to be even and certain, the problem of discounting can be reduced to a rather simple formula. However, if a great deal of uncertainty is associated with the expectation and the flow is irregular, the discounting problem is more complex.

The capitalization process can be summarized by

$$(1)\quad V = \sum_{t=1}^{n} \frac{a_t}{(1+r_t)n}$$

Where V = the present value
n = the time horizon
t = the year within the horizon
a_t = the annual income in year t
r_t = the discount rate in year t

If a_t and r_t are constant and known with certainty, the formula reduces to (2) $V = \frac{a}{r}$ for an infinite time horizon. And, for practical purposes, any horizon over 30 years can be assumed to be infinity.

However, if a and r are increasing, decreasing, or irregular, but known with certainty, the formula must be as in (1).

If we introduce the concept of expectations, then the formula becomes

$$(3)\quad V = \sum_{t=1}^{n} \frac{E\,(a_t)}{(1 + E\,(r_t))^{n}}$$

Where $E(a_t)$ = the expected value of a_t
$E(r_t)$ = the expected value of r_t

In this framework, we are concerned with the stream of future returns and future discount rates. Because these are unknown, we tend to base our expectation on past experience and project this experience into the future. Thus, we infer that $\frac{a_{(t-1)} + \dots + a_{(t-m)}}{m}$ is a suitable proxy for $E(a_t)$. A similar assumption is made with respect to $E(r_t)$ and the problem then is one of determining the validity or certainty of the assumption.

Variables in the Models

Annual Earnings

The major method of determining annual earnings available for capitalization is by using lease rates for allotments. Annual rents reflect the best judgement of operators and allotment owners of the contribution of the program to income. Currently, however, allotments can be rented only within limited geographic areas. Thus, the annual rents might be lower than if allotments were freely rented across county and State lines. In addition, annual rents will reflect the increment to earnings above returns from other crops with other programs in effect. These returns to other crops would be higher than in a free market situation. Thus, the rental rate for a single commodity allotment will be reduced.

An alternative to market rents is to use residual estimates of returns to allotments, but this method seems unlikely to provide useful information. The major problem in making residual estimates is partitioning returns to land, labor, capital, and allotments. The partitioning seems to misrepresent the way the farm operator views his returns. Because land, labor, and capital in general are controlled or owned by one producer, he is concerned with the aggregate returns to the bundle of factors versus the aggregate return to these factors in some other use. His decisions are based on the flow of income in total and not on the separate returns from each asset.

Time Horizon

In most studies of the capitalized value of allotments and in most references to the capitalization process, researchers have assumed a horizon of infinity. The formula is easy to use and the available data do not usually lend themselves to more complex formulas. However, the use of this simple framework has tended to limit thinking concerning capitalization. First, it is generally assumed that program benefits will be the same in every year and that buyers in any future year would pay the same price for program benefits as current buyers. Second, no recovery of investment is assumed except at the termination of ownership. Also, benefits from programs are assumed to be lost to later purchasers for all time.

In reality, allotment buyers are likely to have time horizons of less than 30 years. With the uncertainty surrounding programs, they may be unwilling to consider allotment returns as an income factor for a period of more than 10 to 15 years. Sometimes the period may be as short as 3 or 4 years, if significant changes are occurring in the program.

The shortness of the time horizon is reflected in the capitalization rates implied by the annual program rents and market values for allotments. The higher the implied capitalization rate, the less the weight given to future earnings. For example, assuming a capitalization rate of 25 percent, we could recover about 95 percent of the value in 15 years. At a capitalization rate of 5 percent, we recover only 53 percent of the investment in 15 years. Not only is the perpetuity value higher with a lower discount rate, but the recovery period is longer. If the recovery period is fixed, then the capitalized value is reduced to the level specified by the time horizon.

Raising the capitalization rate not only lowers the discount value of the income stream but shortens the recovery period substantially. Thus, although an individual may assume that programs may continue over a long period, he may be unwilling to risk much on this assumption.

For example, an individual who believes there is a low degree of risk may capitalize program benefits at a 5-percent rate of return. If this is done for a period of 15 years, an income of $50, in the last year, is still worth $25.00 today (table 1). However, at a rate of 25 percent, it is only worth $1.50.

Discount Rates

The basic method available for estimating discount rates from market data is by comparing sales prices and lease rates for allotments. We only have such observations for cotton, peanuts, and rice.

In a few cases, discount rates have been estimated by using regression techniques to arrive at the market value of an acre of allotment and by using other data to determine the added income from an additional acre of allotment. Comparisons of incomes and values have been used to develop ranges for capitalization rates for varying sizes of firms.

Table 1.--Annual rent of $50 capitalized at 5, 15, and 25 percent with cumulated recovery and percentage recovery, by years

Year	Discount rate								
	5 percent			15 percent			25 percent		
	Present value	Cumulated present value		Present value	Cumulated present value		Present value	Cumulated present value	
	Dollars	Dollars	Pct.	Dollars	Dollars	Pct.	Dollars	Dollars	Pct.
1------	47.50	47.50	4.75	43.00	43.00	12.91	40.00	40.00	20.00
2------	45.00	92.50	9.25	37.50	80.50	24.18	32.00	72.00	36.00
3------	43.00	135.50	13.55	33.00	113.50	34.08	25.50	97.50	48.75
4------	41.50	177.50	17.70	28.50	142.00	42.64	20.50	118.00	59.00
5------	39.50	216.50	21.65	25.00	167.00	50.15	16.50	134.50	67.25
6------	37.50	254.00	25.40	22.00	189.00	56.76	13.00	147.50	73.75
7------	36.00	290.00	29.00	19.00	208.00	62.46	10.50	158.00	79.00
8------	34.50	324.50	32.45	16.50	224.50	67.42	8.00	166.00	83.00
9------	33.00	357.50	35.75	14.00	238.50	71.62	6.50	172.50	86.25
10------	31.50	389.00	38.90	12.50	251.00	75.38	5.00	177.50	88.75
11------	30.00	419.00	41.90	10.50	261.50	78.53	4.00	181.50	90.75
12------	28.50	447.50	44.75	9.50	271.00	81.38	3.00	184.50	92.25
13------	27.50	475.00	47.50	8.00	279.00	83.78	2.50	187.00	93.50
14------	26.00	501.00	50.10	7.00	286.00	85.89	2.00	189.00	94.50
15------	25.00	526.00	52.60	6.00	292.00	87.69	1.50	190.50	95.25
∞ ----		1,000.00			333.00			200.00	

If programs have a fairly high uncertainty factor, a short time horizon, and a high discount rate, the following hypothetical model will provide additional information on program benefits.

In the first year of a 3-year program, the land buyer knows that the program will continue for 3 years and this income may be discounted at the same rate as other farm income. More uncertainty is present with the second 3 years and still more with more distant years and programs. It seems logical then to establish a framework for discounting program benefits that incorporates this hypothesis. Starting with the mortgage rate of interest as the discount rate for the first 3 years, 3 to 5 percent is added to the original rate for each succeeding 3-year period. Once the time horizon and discount rate for each period have been estimated, such a system can be converted to a perpetuity income stream in order to compare it with market observations.

Present Value

Theoretically the present value of any capital asset is determined by discounting the future income stream. Elsewhere in this report some of the problems in applying the discounting procedure have been discussed. In this section various methods of estimating present value will be considered.

Market Value of Allotments

The most obvious choice for measurement of value is the price paid to acquire an acre of allotment. This assumes that buyers were in some way able to utilize the discounting process in establishing a present value for allotments.

In a competitive market the value established should closely approximate the future economic value of the allotment. However, available observations of market value are constrained because markets are limited to States and counties. In addition, the market for allotments for a specific crop is affected by other programs which raise the opportunity value of alternative crops. The increment to income from a single program is less, with other programs in existence, than if there were only 1 program.

Market values of allotments may tend to be lower than the opportunity value because allotments are typically transferred from low to high productivity areas. Thus, market prices may reflect more of the opportunity value of production to the seller than to the buyer who may have some surplus that cannot be measured.

Regression Estimates

As an alternative to observing sales of allotments, regression techniques have been used for some commodities to estimate the contribution of an additional acre of allotment to the value of land. These estimates require independence of variables in the equation, some degree of variation of allotments in relation to acreage, and a large number of observations in order to isolate the impact of variations in allotment acreage on land values.

Previous studies in this area have provided little information that can be accepted with any certainty because of the serious intercorrelation problems that exist between variables and the difficulties involved in collection of sufficient data.

Capitalization of Rents

A third alternative for estimating present value is to select a capitalization rate and capitalize the annual rental value of allotments. The capitalization rate may be drawn from observations of other programs or assumed from alternative investments in financial markets. This method can provide a general idea of the capitalized value, but precludes the possibility of setting confidence intervals around the estimate. The true linkage between income and value cannot be documented, but an estimate of what that linkage might be can be made using available empirical data and qualitative judgements of researchers familiar with the problem.

Changes in program benefits as a result of changes in legislation or in administrative interpretation can result in significant shifts in the expectations of allotment owners or potential buyers. Thus, although the overall effect of the program throughout time may be to stabilize income, marginal changes in programs or program administration can cause much uncertainty with respect to program benefits. And as a result the capitalized value of the income stream is affected.

Capitalized Values

The process by which program benefits are capitalized is the same for each commodity, yet the extent of capitalization may be quite different. That is, for any capitalization to occur some increment of income must be available as income (rent) to land or allotments. This source of income may come from diversion payments, marketing certificates, or indirect transfers from consumers through higher prices. Although a dollar of income from any source would have some effect on the value of land, producer expectations with regard to the certainty and stability of the income stream will directly affect the discount rates they use to capitalize income.

Differences in programs and in the ability of individuals to acquire or dispose of allotments or production rights may also cause substantial differences in their expectations about future income.

The following section provides evidence of the value of allotments and the differences in capitalized values and capitalization rates for rice, cotton, peanuts, and tobacco.

Estimates of capitalized values for wheat and feed grains are based on capitalization rates for cotton. In these estimates direct payments are assumed to be a suitable proxy for land returns from the program.

Cotton

Data from the 1966 Cotton Cost Survey show that cotton allotment buyers were willing to pay from \$.12 to \$.27 per pound (table 2). For the same period lease rates for cotton allotments ranged from \$.03 to \$.06 per pound. Rent-to-value ratios (implied discount rates) for allotments ranged from 17 to 40 percent, substantially above the market rate of interest for mortgages. For the United States, capitalization rates averaged 21 percent. These data support the hypothesis that program benefits were heavily discounted. Perhaps one of the major factors associated with the program is the great degree of uncertainty associated with the program and the frequent changes in program regulations.

If all the allotment acres had been rented, at the rates prevailing in 1970, rental payments would have totaled $316 million (table 3). In 1970 direct payments to cotton producers totaled $919 million. Thus, the annual income to allotments, and indirectly to land, is about a third of the direct benefits.

This implies that most of the benefits--two thirds of the direct payments and all of the indirect benefits--are available for other production factors. Cost-of-production estimates show that many cotton producers are apparently relying on program benefits to cover variable production costs (51). Payments used in this way are not available for capitalization.

The cotton program is unique because it is the only program with transferable allotments and direct payments to producers. Rice and peanuts have transferable allotments but no direct payments. Feed grains and wheat have direct payments but are not transferable separate from land, and tobacco allotments can be leased but not sold.

Peanuts

Data from a 1968 survey, made to obtain the value of peanut allotments, show a national average capitalization rate of 12.5

Table 2--Cotton allotments: Prices, rents, and implied capitalization rates Selected States, 1966

State	Purchases		Rentals		Implied capitalization rate
	Observations	Price per pound	Observations	Price per pound	
		Dollars		Dollars	
North Carolina	10	.12	14	.04	.33
South Carolina	5	.15	25	.06	.40
Georgia	25	.12	43	.03	.25
Alabama	32	.18	101	.04	.22
Tennessee	4	.27	24	.05	.19
Mississippi	7	.23	52	.05	.22
Arkansas	19	.22	35	.05	.23
Louisiana	3	.20	3	.04	.20
Oklahoma	2	.13	6	.04	.31
Texas	49	.23	159	.04	.17
New Mexico	1	.24	6	.06	.25
Arizona	1	.25	19	.06	.25
California	13	.26	40	.05	.19

Source: Unpublished data from 1966 Cotton Cost Survey, Economic Research Service

Table 3--Cotton: Allotment values and rents, and direct payments, selected States, 1970

State	Allotments					Direct payments 4/
	Acreage 1/	Value per acre 2/	Total value	Rent per acre 3/	Total rent	
	Acres	Dollars	1,000 dollars	Dollars	1,000 dollars	1,000 dollars
Illinois	2,871	44.28	127	14.76	41	------
Missouri	380,295	136.85	52,043	29.75	11,314	22.449
Kansas	51	30,81	------	9.48	------	------
Virginia	17,112	44.28	758	14.76	253	432
North Carolina	469,240	44.28	20,778	14.76	6,926	14,451
Kentucky	7,295	44.28	323	14.76	108	465
Tennessee	569,489	142.83	81,340	26.45	15,063	34,854
South Carolina	688,519	54.75	37,696	21.90	15,079	32,819
Georgia	817,929	46.68	38,181	11.67	9,545	37,503
Florida	33,924	46.68	1,584	11.67	395	1,088
Alabama	965,800	84.24	81,359	19.12	18,466	49,296
Mississippi	1,596,829	136.85	218,526	29.75	47,506	122,623
Arkansas	1,378,146	110.22	151,899	25.05	34,523	79,578
Louisiana	569,983	110.60	63,040	22.12	12,608	40,410
Oklahoma	755,601	30.81	23,280	9.48	7,163	24,317
Texas	6,857,326	68.31	468,523	11.88	81,465	308,488
New Mexico	181,185	117.60	21,307	29.40	5,327	14,425
Arizona	344,632	224.00	77,198	53.76	18,527	44,403
Nevada	3,637	117.60	428	29.40	107	346
California	774,376	213.72	165,498	41.10	31,826	89,922
United States	-------	------	1,503,788	-----	316,243	919,002

1/ Acreage allotments in 1970.

2/ 1966 Cotton Cost Survey data on value per pound and 1969-71 average harvested yield, based on harvested yield.

3/ 1966 Cotton Cost Survey data on rent per pound and 1969-71 average harvested yield, based on harvested yield.

4/ Direct payments in 1970.

percent compared with 21 percent for cotton (table 4) (40). Apparently, the program benefits are more certain and peanut producers are more confident that they will be continued. No comparison can be made with direct payments but the rental income (cost) from the program would be about $75.3 million if all allotments were rented at the indicated rates.

Rice

Although data on rice allotment values are scant, a California study shows capitalization rates of about 11 percent (16). The rice program has, in general, been about as stable as the peanut program and the implied capitalization rates are similar (table 5).

Since 1962, the rice program has been essentially unchanged except for variations in allotment levels. A unique characteristic of the program is that in Texas, California, and parts of Louisiana allotments can be transferred separately from land. In other States the allotments are tied to specific tracts. Thus, although allotments have a value in and of themselves, land values should be relatively unaffected by the program in producer allotment States. However, when allotments have been purchased, they assume a real value to the owner and he would suffer a substantial capital loss if the program was discontinued.

Tobacco

Tobacco allotments have not been transferable by sale but can be leased within counties.

Table 4.--Peanut allotments: Values and rents per pound, per acre, ratios of rent to value, and total values and rents, 1970

State	Acres 1/	Yield per acre 1/	Price per pound 2/	Rent per pound 2/	Value per acre	Rent per acre	Ratio of rent to value	Total value	Total r
	Acres	Pounds	Dollars	Dollars	Dollars	Dollars		1,000 dollars	1,000 dolla
Missouri	247	2,670	0.20	0.028	534	74.76	.14	132	1
Virginia	104,929	3,060	.20	.028	612	85.68	.14	64,217	8,99
North Carolina	167,975	2,670	.28	.026	748	69.42	.09	125,645	11,66
Tennessee	3,614	1,880	.11	.012	207	22.56	.11	748	82
South Carolina	13,909	1,880	.054	.012	102	22.56	.22	1,419	31
Georgia	529,744	2,220	.18	.024	400	53.28	.12	211,898	28,22
Florida	55,535	2,075	.14	.022	291	45.65	.16	16,161	2,53
Alabama	216,962	1,660	.11	.012	183	19.92	.11	39,704	4,32
Mississippi	7,501	1,100	.11	.012	121	13.20	.11	908	99
Arkansas	4,188	1,100	.11	.012	121	13.20	.11	507	55
Louisiana	1,947	1,100	.11	.012	121	13.20	.11	236	26
Oklahoma	138,427	1,655	.15	.025	248	41.38	.17	34,330	5,72
Texas	357,885	1,405	.20	.025	281	35.12	.12	100,566	12,56
New Mexico	8,333	2,230	.20	.030	446	66.90	.15	3,717	557
Arizona	762	2,230	.15	.025	334	55.75	.17	255	42
California	931	2,230	.15	.025	334	55.75	.17	311	51
United States								600,754	75,280

1/ Acreage allotments and yields in 1970.
2/ Prices and rents developed from Schools, Russell C.

Table 5.--Rice allotments: Acreage and value, selected States, 1970

State	Acreage	Value per acre 1/	Total value
	Acres	Dollars	1,000 dollars
Illinois	22	240	5
Missouri	5,286	240	1,269
North Carolina	43	240	10
Tennessee	575	240	138
South Carolina	3,163	240	759
Florida	1,063	240	255
Mississippi	51,858	240	12,446
Arkansas	443,331	240	106,399
Louisiana	527,761	240	126,663
Oklahoma	166	240	40
Texas	469,211	240	112,610
Arizona	254	240	61
California	333,054	400	133,222
Total	1,835,787	---	493,877

1/ Average value for transferable allotments in Texas applied to all States except California.

Allotment values for tobacco have been estimated to be $3,000 per acre. This estimate is the difference between the value of land with and without a tobacco allotment (table 6) (5).

MVP's (marginal value products) for allotments have also been estimated through linear programming and compared with estimated market values. These estimates imply capitalization rates of 12 percent or more depending on the time period for the study and the techniques used.

Some evidence suggests that capitalization rates for tobacco have been declining over time. However, they are still high in relation to market interest rates for money.

Wheat and Feed Grains

Market estimates of capitalized values for wheat and feed grains are not available. However, benefits under the wheat and feed grain programs may be capitalized at rates close to those for cotton because all 3 programs have about the same year-to-year stability.

Direct payments under the wheat and feed grain programs capitalized at 21 percent (the average rate for cotton) give estimates of about $4.1 billion for wheat and $7.2 billion for feed grains. Such a procedure assumes that direct payments represent the equivalent of total returns to land from both the indirect benefits obtained through the marketplace and the direct payments.

This estimate may represent too high a value for the wheat and feed grain programs (18). In a speech before the Senate Appropriation

Table 6.--Tobacco allotments: Acreage and value, selected States, 1970

State	Acreage	Value per acre 1/	Total value
	Acres	Dollars	1,000 dollars
New York----------	7	3,000	21
Pennsylvania------	120	3,000	360
Minnesota---------	112	3,000	336
Ohio--------------	8,596	3,000	25,788
Indiana-----------	14,536	3,000	43,680
Illinois----------	3	3,000	9
Iowa--------------	7	3,000	21
Missouri----------	2,390	3,000	7,170
Kansas------------	56	3,000	168
Virginia----------	80,737	3,000	242,222
West Virginia-----	2,253	3,000	6,759
North Carolina----	389,211	3,000	1,167,633
Kentucky----------	168,255	3,000	504,765
Tennessee---------	65,941	3,000	197,823
South Carolina----	67,164	3,000	201,823
Georgia-----------	58,963	3,000	176,889
Florida-----------	12,319	3,000	36,957
Alabama-----------	584	3,000	1,752
Arkansas----------	35	3,000	105
Total-----------	871,289	----	2,614,281

1/Allotment values estimated for flue-cured tobacco in North Carolina used for all types of tobacco.

Sub-Committee on June 4, 1969, Secretary Hardin provided data which suggest that approximately 89 percent of the direct payments to feed grain producers in 1968 were for resource adjustment and only 11 percent represented an income supplement. 2/ For wheat producers, 51 percent of the payments were for resource adjustment and 49 percent were for income supplement, compared with 35 and 65 percent for cotton. With a smaller part of the feed grain and wheat payments attributed to added income, the amount of income assumed to be capitalized may be too high.

The resource adjustment or diversion payment would of itself only compensate the producer for income foregone and would not increase land values. But the income supplement would be available for partitioning among land, labor, and capital. If the direct income supplement were used as a measure of the land return from the program instead of total direct benefits, capitalized values for wheat would be halved and values for feed grains would be reduced to 11 percent of the estimate shown in this report. However, such a procedure would assume that only the income supplement from direct payments is available to land and that none of the unmeasured indirect benefits are capitalized. Thus, estimates based on only the income supplement part of the direct payments probably set the lower range of capitalized value for the two programs.

A true capitalized value for wheat and feed grains probably would lie between the estimate based on total direct payments and

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2/ Resource adjustment is a payment in lieu of production.

the estimate based on the direct income supplement.

As wheat allotments and feed grain bases are not transferable, no values of these allotments or bases separate from land values are observable. Theoretically, one could observe differences in size of allotments on similar tracts of land as has been done with tobacco. However, such differences in ratios of allotments to cropland are not likely to be large enough to allow measurement. Since the wheat and feed grain programs have been established, county ASCS committees, which set and administer allotments and programs, have responded to appeals from producers to equalize such allotments. Over time, differences in ratios of allotments to cropland have been gradually reduced so that in any given area the range in these ratios is very small, too small to permit measurement of value. In areas in which grain acreage is a small proportion of total cropland, other crops are more important determinants of land values.

The current wheat and feed grain set-aside programs contain features that would make a given allotment or base take on different values to different producers. Under the current programs, there are two main types of benefits; direct payments in the form of wheat certificates and set-aside payments, and loan rates or supported market prices.

The flexibilities of these programs permit production of wheat or feed grain on many more acres than just the allotment acres. All production is eligible for the price support once the minimum set-aside provision is met. Hence, the first increment of wheat allotment or feed grain base is worth much more to a producer than second or later increments.

Before the set-aside program, participation rates in the feed grain programs were low as compared with such rates in other programs. In some States and in some years, only 1/2 to 2/3 of the eligible feed grain acreage was in the feed grain program.. Producers who did not participate in diversion could still gain the benefits of a stabilized and supported market price. In fact, they may have gained more through price support benefits and production reduction of participants by not participating than if they had participated and received the direct payment benefits.

These facts point up the difficulty of determining capitalized values of allotments or the benefits received by various production factors.

Benefits to Non-Allotment Crops

There are a number of nonallotment crops for which CCC loan rates have been established. These include oats, flax, soybeans, and some others. For these crops, no direct payments are available but prices are supported through CCC loans. Hence, producers of these crops obtain benefits from the program even though they have no allotments. If any benefits are capitalized into asset values, such values accrue to the land or to other factors but are not measurable in terms of value for allotments.

There are numerous other agricultural commodities for which no loan rates are available but their prices are obviously affected by the total commodity program system. Prices of livestock are significantly affected by the price support systems, although no direct support prices apply to livestock. It is likely that some portion of the benefits thus derived are capitalized into rangeland values.

Total Capitalized Value

By adding together the various estimates for commodities, the capitalized value of the benefits associated with the land resources is estimated at $16.5 billion, about 7.9 percent of the value of all farm real estate in 1970 (table7).

Allotment Purchases

The analysis thus far is of the opportunity value of the benefits from the 1970 programs. 3/ What farmers actually paid to acquire program benefits over time has not been discussed. However, this is essential in understanding the magnitude of program influence; for only a small part of the total opportunity value was really purchased.

This can be demonstrated as follows: Each year $4 billion to $5 billion are spent for real estate purchases and these purchases represent about 2 percent of the land in farms (table 8). Some part of this expenditure is for the rights to the benefits from programs. If we can assume that programs have never represented more of the

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3/ Opportunity value is defined as the value of benefit determined as though all investment decisions were made at the beginning of 1970.

Table 7.--Capitalized values of farm program benefits United States, 1970 1/

Region	Cotton 2/	Tobacco 3/	Peanuts 4/	Rice 5/	Wheat 6/	Feed grain 6/	Total	
							All listed programs	As a percentage of real estate value
	1,000 dollars							Percent
Northeast		381			75,300	147,533	223,214	2.04
Lake States		336			173,519	928,663	1,102,518	7.21
Corn Belt	52,170	76,668	132	1,274	444,519	2,790,105	3,364,868	6.96
Northern Plains		168			1,703,471	1,357,352	3,060,991	13.78
Appalachian	103,199	2,119,202	190,610	148	57,604	492,104	2,962,867	19.39
Southeast	158,820	417,421	269,182	1,014	23,081	359,833	1,229,351	9.02
Delta States	433,465	105	1,651	245,508	9,543	89,624	776,896	6.11
Southern Plains	491,703		134,896	112,650	602,076	720,333	2,061,658	7.73
Mountain	98,933		3,972	61	717,872	213,256	1,034,094	6.23
Pacific	165,498		311	133,222	342,853	65,453	707,337	2.67
United States	1,503,788	2,614,281	600,754	493,877	4,149,838	7,161,256	16,523,794	7.94

1/ State data shown in Appendix I.
2/ Based on estimates from 1966 cotton cost survey data on transfer prices per pound of allotment.
3/ Per acre values estimated at $3,000 see Bradford and Thompson (1).
4/ Based on Schools (6).
5/ Based on Grant and Hottel (4).
6/ Direct payments capitalized at 21 percent, the average rate for cotton.

Table 8.--Values of land transferred, values of benefits purchased and unrecovered values in 1970 1/

Year	Value of land transferred	Value of benefits purchased	Value of benefits remaining in 1970
	---------------------	Million dollars	---------------------
1955-------	3,970	314	39
1956-------	4,349	344	49
1957-------	4,299	340	55
1958-------	4,375	345	65
1959-------	4,580	362	78
1960-------	4,516	357	95
1961-------	4,296	339	96
1962-------	4,527	358	117
1963-------	4,503	356	134
1964-------	4,843	383	166
1965-------	4,845	383	191
1966-------	5,207	411	235
1967-------	5,366	424	279
1968-------	5,370	424	321
1969-------	5,180	409	356
1970-------	5,264	415	415
Total---		5,964	2,691

1/ Capitalized values in each year are assumed equal to 7.9 percent of the value of farm real estate as estimated for 1970. These values are discounted at 15 percent. This rate was chosen because it lies between the average rate for cotton and the average rate for peanuts, rice and tobacco.

total value of real estate than in 1970, we can estimate the upper limit of what was paid to acquire benefits by taking 7.9 percent of the value of land transferred in any one year (the percentage estimated for 1970) and summing over the years of purchase. If the true capitalization rate for benefits is 15 percent or higher, a land buyer would have recovered 90 percent or more of what he paid in 15 years of less. Thus, those who purchased benefits more than 15 years ago (before 1955) have, for all practical purposes, recovered their investment. Because of the appreciation in asset value that has occurred, they are, in fact, receiving a windfall stream of income.

If we sum all of the unrecovered investment since 1955, it amounts to only $2.7 billion or slightly less than a year's direct payments to program recipients. This $2.7 billion represents the actual dollars of investment that were paid for benefits but are as yet unrecovered.

The difference between the $16.5 billion opportunity value shown in table and the $2.7 billion unrecovered investment represents windfall gains.

Conclusions

Although estimates of capitalized values presented here have many shortcomings, they provide a reasonable approximation of the impact of farm programs on land values.

Prior to this analysis, it has been assumed by many that most of the benefits from programs were capitalized into land values.

In addition, it was implied that these benefits were lost to operators who purchased land after programs had been established. Also because it was believed that programs were capitalized in perpetuity at relatively low rates; the effects of program removal were believed to include very large capital losses to land owners.

Although this analysis does not absolutely refute these assumptions, the data suggest that the impact of programs on land values and land owners may be less severe than previously supposed.

The relatively high capitalization rates shown seem to imply a high degree of uncertainty concerning program returns. Cost of production data for cotton also show that some part of the benefits are used to purchase annual production inputs, and rental data demonstrate that at least part of the benefit stream goes to labor and management.

This analysis has been largely concerned with the opportunity value of program benefits or the amount farm operators would have paid to acquire their benefits if all investment decisions had been made in 1970. That is, how much would farmers have been willing to pay to purchase the expected income stream from the programs. In a competitive market, this value should be equal to the discounted present value of the income stream. However, the market for allotments and program benefits is not fully competitive and there exists some surplus to the buyers of allotments.

Although the capitalized value of program benefits on an opportunity cost basis is rather large--8 percent of the total value of real estate--the actual investment of land owners in program rights seems to be rather small.

CHAPTER VI

THE ENLARGEMENT DEMAND HYPOTHESIS

Over the last 3 decades the average size of a farm operating unit has increased dramatically rising from 175 acres in 1940 to about 380 acres in 1970. (45) During this period the number of farm operating units fell from 6.1 million to 2.9 million. However, land in farms increased from 1,065 million acres in 1940 to 1,161 million acres in 1950. By 1970 land in farms had decreased to 1,121 million acres.

Since 1950 the number of farm real estate transfers has declined as both the rate of transfers per 1,000 farms decreased and the total number of farms declined. However, the percentage of transfers for farm enlargement purposes increased from 23 percent of all transfers in 1950 to 61 percent of all transfers in 1970. (table 9) As the total number of transfers declined, the increasing percentage of enlargement transfers held the number of enlargement transfers nearly constant while the number of complete unit transfers fell sharply.

The data presented above seem to lend support to the hypothesis that the demand for land for farm enlargement has been a major factor in the upward movement of land prices since 1940, because the proportion of farms transferred for enlargement purposes has increased sharply. However, aggregate data on returns on the market value of farm real estate show that average returns have ranged from 2 to 6 percent over the 3 decade period.[56] Returns at this level seem

Table 9.--Total farm land transfers, farm enlargement transfers and percentage of transfers for enlargement 1950-1970

Year	All transfers	Enlargement transfers	
		number	as a percentage of total
	Thousand	Thousand	Percent
1950----	280.9	64.6	23
1951----	282.5	67.8	24
1952----	264.7	68.8	26
1953----	234.8	65.7	28
1954----	210.8	61.1	29
1955----	201.0	67.5	32
1956----	205.6	67.8	33
1957----	188.9	71.8	38
1958----	180.2	72.1	40
1959----	174.5	73.3	42
1960----	169.1	76.1	45
1961----	154.6	71.1	46
1962----	154.7	71.6	46
1963----	146.0	70.1	48
1964----	148.1	74.1	50
1965----	138.5	74.8	54
1966----	136.7	73.8	54
1967----	128.8	66.9	52
1968----	123.2	70.2	57
1969----	122.0	73.2	60
1970----	108.7	66.3	61

Source: Unpublished data ERS-USDA.

low in relation to other investment alternatives over the same period. Thus, a question is raised as to why farmers continue to buy real estate at even higher prices.

Also estimates of the rates of transfer are based on transfers of ownership units. These rates of transfer are applied to the number of farm operating units to arrive at the number of farm transfers. This is a valid procedure only if ownership units are declining at the same rate as the number of farm operating units. Currently, no estimates are available on the number of ownership units or the rate of change in ownership units. However, if we look at the changes in leasing patterns, we find an increasing number of farm operators renting from several landlords and this may indicate that the decline in ownership units is less rapid than the decline in operating units. (57).

Changes in the average size of farms are not entirely the result of farm enlargement purchases. Some of the change comes from the rental of additional land, however, most of the change is the result of small tracts being dropped from the lower end of the size distribution (36).

This chapter focuses on the farm enlargement demand hypothesis as an explanation of the trend in farm land values. The discussion deals with the problem of specification of supply and demand factors and attempts to isolate the impact of both supply and demand changes.

As with other chapters, the discussion will first be theoretical and then empirical.

If the firms in a competitive industry are organized such that zero profits are being earned (average cost equals average revenue) and an equilibrium situation prevails, something must affect the supply--demand relationship for any change to occur; i.e. firms attempt to adjust to new price or production relationships. We might envision a change in demand for the output of the firm or industry, a change in the supply of inputs to the firm or industry, or a shift in technology which causes a change in the supply curve of the firm and thus in the supply curve of the industry. Within agriculture all of these have occurred simultaneously; thus, the problem of specification is quite important in the analysis.

Assume that the firms in a competitive industry are optimally organized with zero profit where average cost equals average revenue. Also assume that technological change occurs shifting the long-run average cost curve for the firms in the industry downward and to the right. The new optimum size of plant will be larger than in the previous equilibrium situation. This will, in the absence of barriers to entry, induce new firms to enter the market to capture profits and will induce current firms to expand. If the MVP of the factors is above the acquisition price and the supply of the resource is elastic, new firms will enter the industry at the optimum size of plant, expanding production and driving the price of the product down to the new average cost curve. On the other hand, under competitive conditions with a somewhat inelastic supply of resources to the industry

The entrance of new firms and the attempts of old firms to expand would drive up the price of the resources causing an upward shift in the cost curves until a new equilibrium is reached. At this point, output has expanded beyond previous levels with no shift in the aggregate demand curve for the commodities produced and the price of the commodity will fall as output expands.

The competitive model assumes the divisibility of resources and an elastic supply curve for inputs for each firm so that each firm acting independently cannot affect the price of the resource and uses the resources to the point where marginal value product equals the price of the factor. However, land, although measurable in acres, is typically bought and sold in discrete units much larger than one acre in size. These units are determined by the present ownership pattern and tend to cluster at multiples of 80 acres. To be sure, there are tracts of all sizes in between, but they occur less frequently. Also ownership tracts tend to be smaller than the optimum size of land base needed for effectively organized plants under today's technology, because the pattern of ownership developed during the period when the optimum size of unit was smaller. Thus, a barrier to entry exists for new firms. 1/ New entrants may find a tract that they could buy; however, it is too small to allow them

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1/ This point is supported by data from the Census of Agriculture which shows that the number of full owner farms is declining in relation to the number of part owner-part renter farms and that full owner farms are about one half the size of part owner farms.

to enter the industry with an efficient operation. On the other hand, add-on buyers may find that purchase of a small additional unit places them near the most efficient plant on their longrun average cost curve. Thus, their returns are improved from the previous positions with a capital investment which is relatively small compared to the new unit. Additionally, the add-on buyer may find debt capital much more readily available. He can, in fact, either mortgage his existing operation and use it to pay for the property or can pledge it and the new property as collateral for the loan, thus eliminating or at least reducing the need for a down payment. He may also have the advantage of adjusting the size of the operation rather than increasing the scale. The credit, machinery and labor requirements in such an adjustment are, therefore, less for the add-on buyer than for the beginning operator.

Although technology has been changing continuously in this century, the most rapid advance occurred after 1940. Thus, during the earlier years of this century the most efficient size of plant did not change rapidly and farms tended to transfer in blocks which were near the optimum size of operation, i.e., ownership units were approximately the same size as farm operating units. Also land for farm production purposes was still available outside the farming sector and could be brought into production using approximately the same proportion of capital and labor that was being used on operating farms. No major shifts occurred in the relative use of capital, labor and land and, therefore, a close relationship existed between the changes in farm income and land prices. However, from 1940 forward (perhaps from 1930) changes in production techniques caused a rapid change in the combination of inputs that were required to achieve optimum size. Also, addition of new land to the farm plant nearly stopped, as only those lands that required substantial capital inputs for irrigation or clearing were added.

The changes occurring in technology that enabled the farm operator to spread his labor and capital over more acres resulted in an upward trend in the average size of operating unit. Early adopters of technology could earn greater returns by producing more per acre and by producing on more acres. Since the addition of new land to agriculture was not economically feasible, in most areas, firms grew by acquiring land from other farm operators. The buyers expected returns had to equal those of the seller for the property to transfer.

In addition to the disequilibrium created by technological change, farm price support programs tended to hold product prices above open market clearing levels. The incentive to expand the size of farms continued to exist long after the technological change had been complete.

Increased gross income per farm appears to be largely the result of both technological change and price and income support programs. However, because of the shift in the combination of inputs, the increased gross return per farm is allocated differently among the factors of production than in the period before 1930. Although the physical land input in the aggregate has not changed greatly, it is used in conjunction with a greatly reduced labor input and a different, if not actually increased, capital input. In this environment firms will attempt to employ slack resources in a manner that will increase their net incomes. If this can be done only by acquiring additional land, they will attempt to bid land away from the current owners to achieve their income objective.

Heady and Tweeten find that "...based on the strong upward trend in farm size and the coefficient of (average) acres of cropland harvested per farm, the major source of real estate price increases in the past decade (1950-1960) has been from consolidation and associated scale economies from large acreages." However, if we could correct the yearly changes in the average crop acres harvested per farm for purely statistical movements, we would find that farm size increases have been less dramatic from the purchase of additional land than from the fact that larger farms remained as farms. That is, changes in the average acreage of cropland per farm occur not only because farm operators buy and sell land but because of the disappearance of farms from the lower end of the size distribution. Because most of the farms that are lost from agriculture uses are lost from the farms that are smaller than average, the remaining farms have an average size that is larger even though none of the remaining farms have bought or sold land. The result of this statistical phenomenon is an upward bias in the observation on changes in the average size of farm because the population of farms is changing over time.

The true farm enlargement quantity variable should measure the acres of land purchased for farm enlargement by owner operators. Purchases by landlords to increase the size of ownership units should probably not be included because land owned by landlords can be rented out to different individuals. However, no data series is available either on a state, regional or national basis that separates the acres purchased for enlargement from the acres purchased for complete units or nonfarm use.

In the absence of such a series, the best proxy would be the change in farm size attributable to purchase and rental as shown in "Changes in Farm Size" (26). The problem with this variable is that it must be a straight line interpolation between census years.

Supply of Tracts Available for Purchase

I have already stated in this chapter that the number of land ownership units in farms exceeds the number of farm operations; thus, the average size of an ownership unit is less than the average size of farm. Because it is the land ownership unit that transfers in the market, rather than the farm operation, the average size of tract sold or rented is less than the average size of farm. Thus, the quality of tract available in the market facilitates the expansion of farm size for current operators and creates a barrier to entry for new operators. Firms with an on-going operation may increase their size by the

the acquisition of an additional 80 or 160 acres. New firms need to acquire 2 to 3 times that acreage in many areas to reach the most suitable size of plant.

Because real estate market areas are typically small and, on the average, only 2 or 3 percent of the farms transfer in any one year, the additional demand placed on a local market by someone seeking a complete farm unit could have a greater than proportional impact on land price in the area. In reality, it is unlikely that a suitable tract or suitable number of tracts would be offered for sale in a specific market area to form a completely new farm unit. Since new land is not readily available, it is not surprising that smaller farm units are added to other farms where such additions are practical.

Fixed Assets, Overhead Cost and Farm Enlargement

Frequently, economists have implied that farm operators buy land to spread overhead cost or fixed cost over a larger number of acres or over a larger number of output units. The assumption underlying this statement is that operators have excess labor management or non-real estate capital that they cannot utilize except in combination with additional land. Therefore, by adding more land, average fixed (overhead) costs are reduced and the spread between average total costs and average revenue is increased. This increase in profits per unit is assumed to be allocated to the additional land purchased to justify higher prices paid for farm land. Although this excess capacity hypotheses may provide the explanation for some purchases, we must inquire why the excess capacity existed to begin with; that is, what is the source of excess labor, management or nonreal estate capital?

Two factors stand out as reasons for excess capacity: technological change and the lumpiness of inputs. For example, under existing technology one man and one machine may be able to handle 150 acres maximum. However, when the machine is replaced, the new machine has been modified in such a way that one man can now operate up to 200 acres. If the new machine is available at only a slight increase in cost or if the buyer places a high preference on leisure time, he may acquire the larger machine. If his preference for leisure changes or he can hire additional labor and more land becomes available, it would seem rational to acquire the additional 50 acres to use the machine to capacity.

An additional factor that can influence the amount of excess capacity is the restriction placed on the percentage of cropland that can be used for production of wheat, feed grains and cotton. Such a restriction can cause under-employment of labor and nonreal estate capital that is fixed to the firm. In such cases, the firm may attempt to acquire a larger land base to keep labor and capital fully employed. The problem faced by the operator is that he must consider the bundle of returns to all assets in making his decision, not just the returns to one factor of production. If the returns to the aggregate bundle of inputs are greater in farm production than in nonfarm uses, then inputs will be employed in agriculture even though higher returns might be available to one factor in nonfarm employment.

Because the rights to the income from the separate factors of production are typically possessed by the operator, partitioning these returns among the separate factors does not add to the decision making process as firms consider whether or not to enter or leave or modify farm production. The firm ceases to exist only when the combined earnings of the factors fall below the level of combined earnings elsewhere. Thus, land is offered for sale only as the firms earnings in agriculture are found to be below the combined earnings from nonfarm employment. Frequently in the case of older operators even the reduced earnings from production may not be sufficient to induce a sale if the family can live at a lower cost on the farm than in a residential area or if there is a strong attachment to the values of rural living.

It has been argued by some that farm operators hold land because of the expectation of capital gains from price changes. A counter argument to this would be that farm operators with low income hold land because they realize that acquisition of other land would require a higher investment per acre and reduce earning below current levels. Also, loss of land would result in a loss of labor and management returns. They recognize that exit is possible but that reentry is much more difficult. Thus, land may be offered for sale when the firm ceases to exist or it may be held until the owner dies because it provides the least cost residence for the family. In this case, whatever capital gains there are accrue to the heirs rather than the owner of the property.

Emperical Evidence

Most of the national studies that specifically included farm enlargement as a factor explaining the price of real estate have introduced it in the model as a single variable in a group of simultaneous equations. Enlargement demand has been represented by such factors as the average size of farm, the percentage of transfers for farm enlargement or the average acres of cropland harvested per farm.

In most of these studies, the farm enlargement variable was found to be significant in explaining land price increases. Heady and Tweeten found that the strong upward trend in size was the major source of price increases. [20]

Reynolds also reached essentially the same conclusion, reasoning along the same line as Heady and Tweeten, that spreading fixed cost over a larger acreage allows a farm operator to pay more for an additional unit than he paid for his base unit.

This argament is valid only if some of the firms resources are slack resources or the firm has excess labor, management or equipment at its present size that cannot be employed more profitably elsewhere.

An alternative rationale is that although the firm has its resources fully employed in the current plant, incorporation of new technology would allow changes in the size of operation that would reduce cost and increase earnings.

The first view assumes that excess capacity exists in the current plant. The second view assumes that a new plant size will be needed to incorporate different technology. Both views appear as reasonable explanations of the farm enlargement phenomenon.

The effect of both is the same so long as costs per acre are reduced and per acre net income is increased. However, if the result of technological change, in the aggregate, was to increase total output and lower the price of the commodity produced so that total revenue fell, firms paying more for land, based on short run increased earnings, could suffer a capital loss as net returns fell below the short run expectations.

The conditions for growth in the size of firm in acres, therefore, seem to depend on a stable or increasing return per acre. This has occurred since 1940 because of both an increasing demand for certain commodities and price stabilization for others through federal programs.

The farm enlargement phenomenon is, therefore, not independent of other variables included in many of the models and we would expect changes in farm size to be closely related to technology and farm programs which cause under-employment of fixed resources.

Critique of Previous Models

Herdt and Cochrane have developed a model of the land transfer market as $N^s = f(P,R,U,LF)$ where N^s = number of transfers per thousand farms

P = price of land in current dollars

U = unemployment as a percentage of the civilian labor force

and Lf - millions of acres of land in
farms.

A serious problem with the model is that N^s is assumed to represent the quantity of land transferred because it is assumed that the average size of tracts sold changes in proportion with the average size of farm and, therefore, acres of land sold would be increasing as the average size of farm increased. However, although the average size of farm has been increasing, the average size of tracts transferred has remained fairly constant over time; thus, acres of land transferring would decline faster than implied by the Herdt and Cochrane model.

A better measure of the quantity of land transferred would be the number of transfers per thousand farms times the number of farms with the average size of tract transferred assumed constant.

Heady and Tweeten use acres of crop land harvested per farm as a proxy for farm enlargement in their model. However, they may as well have used the average size of farm because both series follow almost identical trends over time. The major problem associated with these variables is that much of the change in average size or average acres of harvested cropland is a result of purely statistical phenomena. First, farms lost from census counts, because they no longer have sufficient agricultural production, are generally smaller than the average size of farm. These tracts move to nonfarm use or lay idle and, therefore, the land in these tracts is removed from the aggregate farm plant. Because these farms are smaller than the average size of farms, the average of the remaining farms increases without land being added to them. Secondly, farms that are used to enlarge other farms are also smaller than the average size of farm; and, therefore, the average is increased by the loss of numbers from the smaller size classes.

It has been shown that less than 1/3 of the increase in the average size of farm from 1959 to 1964 was the result of adding land to farms [38, p.33]. The remaining 2/3 was purely statistical change.

Conclusions

It seems doubtful that the impact of the farm enlargement supply and demand conditions can be captured in a single variable because the quantity of land demand for enlargement is in fact a function of changes in technology constrained by changes in farm program benefits along with the price of land. In order to attribute a price effect to farm enlargement as a factor in the land market, we would need to show that it has a unique impact on land values in the absence of changes in other factors. This has not been accomplished in this manuscript or any other manuscript reviewed for this thesis.

The major point that can be made is that farm enlargement seems to be a function of technological change and farm programs which modify the most efficient size of plant and therefore, affect land returns and, therefore, the demand for land. The demand for land for enlargement purposes should be determined by the same factors that affect the demand for whole farm units. However, the characteristics of the tracts available for purchase limit the transfers to mainly those which are for enlargement purposes.

CHAPTER VII

THE EFFECT OF SELLER FINANCING ON LAND PRICES

Variations in the terms of credit used for financing land transfers may affect the price of real estate. The influence of credit terms can become particularly important when the seller provides financing, because the terms of credit--interest rate, downpayment and years--become negotiable along with the price of the property.

This chapter is an analysis of the impact of various financial arrangements on the price of a property. Specifically, it considers the trade-off between other negotiable factors and the price from the viewpoint of the seller. The major assumption of the chapter is that the seller would be indifferent to a combination of price and terms which leaves the present value of the property unchanged from the present value of a cash sale. In each case present value is computed after taxes. The analysis is presented in terms of the minimum price acceptable to the seller under each credit arrangement given a fixed cash price for the tract.

No analysis has been made from the buyers viewpoint. Although it might be possible to simulate the buyers side of a sale the number of factors which must be considered and the restricting assumptions needed place this type of inquiry beyond the scope of this chapter. Estimates of the impact of seller financing on the per acre price of real estate are shown in the last part of the chapter. Also because the technique used appeared to be valuable for management, a more complete discussion of the model is presented in an appendix to this thesis.

Increasing Importance of Seller Financing

Over the last 20 years an increasing volume of credit has been used to finance the transfer of farm real estate. Much of this larger volume has been provided by the sellers of farm property in the form of installment land contracts. Within the last 5 years installment contracts have become more important as the institutional credit markets tightened and insurance companies--a major class of lenders in the farm real estate market--reduced their farm lending for various reasons. [55]

The increasing importance of seller financing and rising land prices caused many people to speculate about the effect of seller financing on land prices. A general conclusion derived from these speculations was that seller financing tends to inflate prices in the land market. The following analysis will attempt to test this hypothesis.

Possible Aggregate Affect of Seller Financing

If in fact, seller financing adds to the quantity of funds available for real estate purchases and the quantity of land available for transfer in any one year remains relatively fixed, seller financing will exert an upward pressure on land prices. Because buyers who could not ordinarily have purchased land will enter the market. Thus, seller financing through its effect as a credit expansion machanism could cause a shift in the demand for farm real estate. On the other hand, if legislation were inacted making seller financing contracts illegal, the price of real estate could fall as an excess of tracts entered the market at current prices.

Even in the absence of such legislation, the net expansionary effect of seller financing may be minimized because sellers are not only suppliers of credit but also suppliers of land. Thus, the land which they offer or sell under contract might not be a part of the short run market supply if they were not allowed to participate in the financing. It would seem that the net addition of credit and the net addition of land could have an offsetting effect on market prices.

Effect of Credit Terms on Individual Sales

The seller of a tract has several choices in selling his property. He can sell it for cash, in which case he is not concerned with the buyers credit arrangements. Or he may sell and finance the property taking back a mortgage or using a land installment contract. Under the installment contract he may sell using a fully amortized contract or a balloon contract.

The basic distinction between an installment land contract and a mortgage is that the title is generally transferred at the time of sale with a mortgage. Under a contract sale the title remains in the hands of the seller until such time as specified in the contract. This simple distinction would not cause a price difference between the two credit arrangements although they would both differ in price from a cash sale. The only effect that might exist would be a slight adjustment in interest rate to account for a difference in risk, if any, between the two instruments.

Beyond the basic difference of title change certain Federal income tax regulations, specifying how income is reported, affect returns to the seller under both the mortgage and land contract. Under a mortgage sale with a downpayment of more than 30 percent of the sale price, capital gains taxes due on the property are payable in the year of sale. Under an installment purchase agreement (land contract) with less than 30 percent downpayment and an interest rate of 4 percent or more, part of the capital gains tax can be deferred to later years. Thus, income and taxes are reduced in the year of sale and increased in later years. In most cases this results in a lower total tax for the seller on the sale of a property, because taxable income for many sellers is lower in succeeding years than in the year of sale.

Under either type of financing it is possible for the seller to reduce the rate of interest and capitalize the difference into the price of the property. Because of the tax regulations, there seems to be more advantage to this under the land contract than under the mortgage.

Analysis

The impact of changes in various credit terms on the price of a property were tested by simulating the seller decision process. The simulator accounts for possible differences in tax regulations that may influence the returns from a sale and allows variations in repayment schedules, interest rates, downpayments and discount rates. In order to test the impact of various credit terms on the price, the present value and the discount rate are held constant and the price is varied so that the seller is made indifferent to any combination of credit terms. The price difference that occurs shows the effect of a change from one combination of credit terms to another. The results show prices which would leave the seller as well off under any situation. However they tell us nothing about the effect on the buyer or about the bargaining position of the buyer and seller.

One would expect the basic price of the property to be based on the discounted present value of its future income stream and that the terms of credit would influence the price as they modify the income stream from the property. The effect of the terms on the sellers income stream and therefore on the price are shown in the following section.

Assume, for the purpose of this discussion, a property that would sell for $100,000 at current prices as a cash sale. The property has a cost basis to the seller, for tax purposes, of $60,000 and therefore the seller has gross capital gains of $40,000. If the seller had no other income in the year of sale, the after tax value of the sale under a joint income tax schedule would be $95,620. This analysis assumes that selling costs are insignificant and disregards State taxes. If either were present the result would be to reduce the aftertax present value further but that does not disturb the comparison.

In the following analysis the aftertax value of the property is held constant at $95,620. Variations in interest rate, price, years, and downpayment are introduced in order to determine their effect. Tax rates are allowed to vary so that a true aftertax comparison of all sales can be made. The discount rate is held constant at 7 percent for all sales. This could have been varied but it did not seem realistic for a single seller, thus the same discount rate was used no matter what terms were offered for the property.

About 500 combinations of terms were considered in the analysis and a massive number of other combinations are possible. However, to simplify the presentation only a few are presented in detail, certain others are shown graphically.

The basic comparisons are: (1) $100,000 cash sale, (2) a seller financed sale with a $40,000 downpayment, (3) a seller financed sale with a $29,000 downpayment and (4) a seller financed sale with a balloon payment clause. These are compared at interest rates of 7 percent and 9 percent. These credit arrangements were chosen because they are fairly typical of credit terms observed in the market. Mortgages typically require a 40 percent downpayment, contract sales are generally for less than 30 percent down and frequently include a balloon payment after a short repayment period. Comparisons of other credit arrangements are of course possible and have been examined. However, direct comparisons of mortgages and land contracts of the same downpayment and length of term do not seem realistic because of IRS regulation.

Using a mortgage sale with a $40,000 downpayment and a 9 percent interest rate, the seller would be as well off as with a cash sale if he could sell the property for $96,909 (table 10). At a 7 percent interest rate, he would need to have $106.700.

Table10.--Selected seller financing arrangements with a constant present value

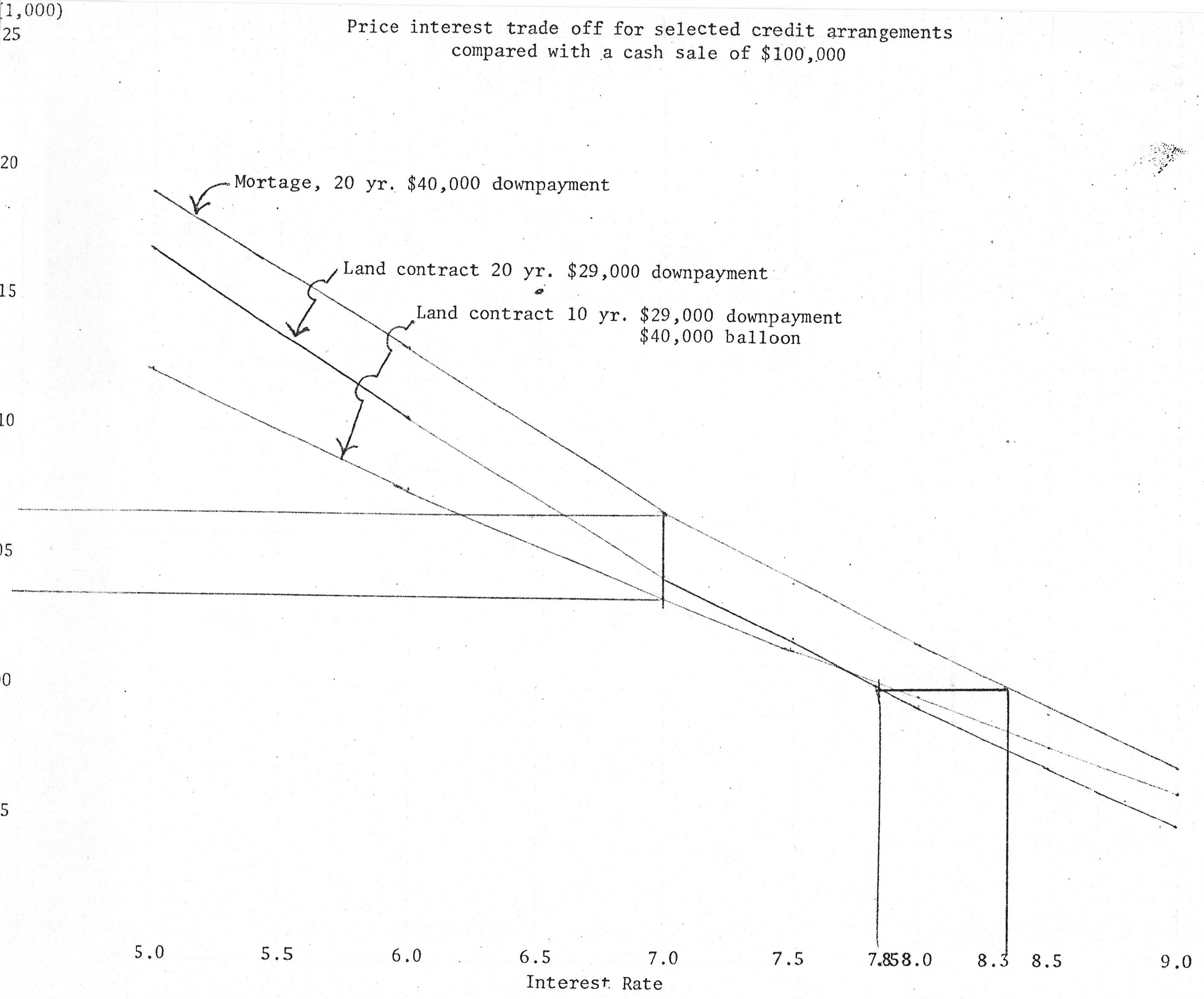
Method of financing	Price	Down payment	Year	Interest rate	Balloon	Present value
Cash-------------	100,000	---	--	--	---	95,620
Mortgage I-------	96,909	40,000	20	9	---	95,620
Mortgage II------	106,686	40,000	20	7	---	95,620
Land Contract I--	94,522	29,000	20	9	---	95,620
Land Contract II-	104,410	29,000	20	7	---	95,620
Land Contract III	95,900	29,000	10	9	40,000	95,620
Land Contract IV-	103,430	29,000	10	7	40,000	95,620

Some evidence exists that indicates an interest spread of 2 percent between contract financing and commercial mortgage financing. However, on an other things equal basis this seems like too large a spread, because, there is a trade off between other terms and interest rate as well as between interest rate and price. The results of the model show that the terms of credit are likely to be important in price formation. Within the range of the data examined price ranged from as much as 20 percent above a cash sale for a mortgage to 6 percent below for a land contract (fig. 1). Only under very special combinations of terms and discount rates would a mortgage or land contract sale be equal in price to a cash sale. Financing the sale required a higher price for the property in most situations than would be required on a cash basis because of the effect of the discounting procedure.

For any given set of credit terms Federal income tax treatment provides a distinct advantage for installment purchase agreements over seller mortgages. However, because terms differ considerably between mortgages and land contract, tracts financed by contract may in fact sell for a higher price on the average than cash or mortgage sales.

Referring to figure 1, each line on the chart represents those combinations of price and interest rate that would leave the seller with the same present value as a cash sale of $100,000, all other factors constant. For example, a seller would receive the same present value from a $100,000 cash sale or from a sale of $110,000

Price interest trade off for selected credit arrangements
compared with a cash sale of $100,000



taking back a mortgage of $70,000 for 20 years at 6.5 percent with a down payment of $40,000. From the chart it is possible to compare the effect of various financing arrangements on the price of a property at any given interest rate or to show the spread in interest rates at any price. At an interest rate of 7 percent the price would rise to $103,200 for a 10 year contract with a balloon of $40,000, $104,410 for a 20 year contract with no balloon or $106,700 for a 20 year mortgage with a $40,000 downpayment.

On the other hand if the sale price was held at $100,000 both contracts would carry an interest rate of 7.85 percent and the mortgage would be financed at 8.3 percent.

If the spread between the interest rates exceeds that shown on the chart the contract would be expected to sell for a higher price than the mortgage. If for example, a spread of 1.5 percent existed between the mortgage rate and the contract rate and the market rate for mortgages was 8.0 percent the tract would sell for $101,500 under a mortgage, $105,500 under the 10 year balloon contract, and $107,500 under the 20 year contract with $29,000 downpayment.

The price spread between the 20 year contract and the 20 year mortgage is the result of tax advantages of the contract and the difference in downpayment which offsets some of the tax advantage. The change in slope associated with the balloon contract is basically the result of the shorter term and the increase in interest income from less than complete amortization.

Influence of Credit Terms on Aggregate Price Level

The scarcity of data on the distribution of credit arrangements and the great variety of credit arrangements in the real estate market made it difficult to draw an inference from the analysis on the influence of credit terms on the level of real estate prices. However, it appears that the net impact of seller financing has been to raise the level of price above that which would persist in the absence of such arrangements. This impact comes from increased demand for land and the trade off between credit terms and price. The net impact from credit terms depends on the distribution of various credit arrangements in the market and on the change in the distribution of terms and the change in the proportion of sales that are credit financed.

If the average impact of seller financing was to raise the level of values 10 percent above the cash price and seller financing was involved in 22 percent of all sales, as in 1965, the level of value without seller financing might have been $143 per acre rather than $146 as shown for all land. From 1965 to 1970 the percentage of all sales financed by sellers land contracts increased from 22 percent to 37 percent. If the average price difference remained the same 10 percent over the period, the cash price would have been about $186, $7 below the reported $193.

Therefore, the effect of the increased percentage of contracts could have been a 2 percent greater rise in land prices than would have occurred if the proportion of contracts had remained the same.

If the spread between the contract interest rate and the mortgage interest rate increased, as some have hypothesized, land values would have increased even more. Suppose that the average difference between a contract price and a cash sale increased from 10 percent to 15 percent. The average cash value would have been about $182 rather than $193 and the combined effect of an increase in the proportion of contracts and an increase in the spread between seller mortgages interest rates and contracts rate would have been a 5 percent more rapid increase in value than would have occurred under unchanged conditions.

These estimates suggest that the absolute level of market prices is influenced by the terms of seller financing in the market. Any shift in these credit terms can have a significant effect on what we observe about market behavior in the aggregate--and on the price of individual tracts.

CHAPTER VIII

NONFARM FACTORS AND FARMLAND VALUES

Since 1950 a growing concern has been expressed over the rapid spread of our cities into farmland areas and increasingly this concern has been focused on the impact of suburban growth on the local environment and on the dramatic impact of changing land use on the farms in the rural-urban fringe.

State legislatures, in an attempt to improve the lot of farm operators in fringe areas, have passed many forms of preferential real estate tax laws that recognize the difference between the value of land in farm production and the market value of a tract of land in the urban fringe area.

In addition to the immediate impact of suburbanization on land values in the urban fringe, the demands of a growing urban population on land in more remote areas appear to have increased as many of the amenities of land ownership are separated from the urban setting.

These complex pressures on rural land are the subject of discussion in this chapter.

Rural Urban Competition for Land

Two major factors seem to have contributed to the increased demand for land for use in urban areas. One is the increase in total population and the second is the migration from rural to urban or suburban areas. The migration itself is largely the result of increased economic opportunity for individuals in the urban environment versus the rural area. Dramatic shifts in technology within and outside the farm sector, and changes in the tastes and preferences of individuals appear to have been important in creating these nonfarm opportunities. The net impact of these changes is reflected in the allocation of a larger percentage of our fixed land base to urban and suburban economic activity and small but continuous reductions in the quantity of land in agricultural and related uses.

The concentration of people into a few large metropolitan areas appears to have two major impacts on farm real estate values. First, in the more remote areas with stable or declining population the pressure on land value from nonfarm sources would seem to be reduced while land values in more urban areas would be expected to shift upward because of the increasing populations demand for homes, offices and factories. This increased concentration of people, for housing and production, has the effect of separating several uses of land and in effect multiplies the demands made on land within the nation.

Housing, for example, tends to be separated from production; and marketing is separated from both; while recreation is in general isolated from other factors. In addition other areas are set aside for single purpose functions such as game refuges, wilderness areas, and waste disposal areas.

This fractionalization of land uses into mutually exclusive categories seems to have contributed to rising land values within urban, suburban and rural areas.

In addition to the direct impact of urbanization, many of the more rural areas of the nation are experiencing a growth in nonfarm job opportunities and the percentage of "farmers" working off the farm on a part-time basis has increased rather sharply. Nonfarm jobs are now a major source of income to farm people. In 1970 the average off-farm income per farm operator family exceeded the realized real income per farm operator family for the 1.8 million farms with less than $10,000 in gross sales. [57] Average off-farm income for farms with gross sales of $10,000 to $20,000 average half of net farm income and even those farms with $20,000 to $40,000 of gross sales had off-farm income which was more than one third of their realized net. Thus farm operator families are not entirely dependent on farm income to pay for their land and the amenities that go with it. The value of the "non-production" amenities to farmland may, therefore, be valued in a market which crosses from the farm to nonfarm household accounts.

Some evidence of the impact of nonfarm influence can be shown by observing regional differences in net cash rent to market value ratios for farmland (table 11). For example, in the Northeast region net rents have been less than 3 percent of market value since 1962 and the percentage has been declining. A similar pattern exists in the Pacific Region. In other regions net rents represent larger percentages of the market value and in the Northern Plains and Corn Belt rent to value rates have remained fairly stable.

Table 11.--Farm real estate transfers: Average value per acre by potential use after sales, year end March 1, 1970 1/

Region	Potential use								
	Agri only	Forestry	Minerals	Recreation	Rural residence	Subdivision	Commercial	Industrial	All use 2/
	---Dollars---								
Northeast	355	241	265	359	416	552	707	1,185	375
Lake States	276	162	78	202	294	549	443	721	290
Corn Belt	425	235	368	276	367	571	571	1,338	405
Northern Plains	130	123	172	88	198	341	109	510	140
Appalachian	241	148	269	289	404	466	841	321	315
Southeast	272	184	116	259	370	571	668	1,137	280
Delta States	306	161	87	82	177	440	490	637	272
Southern Plains	171	171	146	143	256	329	638	461	169
Mountain	87	62	126	101	177	178	355	400	114
Pacific	365	296	---	309	745	212	390	1,146	345
48 States	215	126	223	175	327	300	505	931	233

1/ Data represents the average values reported on 13,500 sales in the October 1970 and March 1971 survey.
2/ Does not include approximately 50,000 acres classified as other potential uses in the surveys.

The evidence, although not conclusive, implies increasing urban pressure in the Pacific and Northeast Regions and a fairly constant nonfarm influence in the Corn Belt and Plains States. Additional evidence on the impact of nonfarm demand on farm land values was obtained from farm real estate brokers in October 1970 and March 1971 (table 12).

Reporters to the 2 surveys were asked to identify the influence of specific nonfarm use categories on tracts of land sold for farming purposes. A comparison of average values by potential use categories lends support to the urban influence hypothesis. However, the results are again far from conclusive as to the magnitude of the nonfarm influence.

Data from a March 1972 survey of farm real estate brokers show that 20 percent of the tracts bought for farming purposes in the year ended March 1, 1972, are expected to move to nonfarm use in 5 years. [55] However, half of these tracts (10 percent of all tracts) were to remain in rural residential use. In addition to these tracts that were expected to move out of farm use in a 5 year period, data was collected on farm tracts that were sold for nonfarm purposes during the year. Of the tracts observed, 38 percent were going into subdivision use, 18 percent for rural residential use, 15 percent for commercial and industrial use and 14 percent for recreational uses.

Perhaps the most that can be said from the data is that some urban influence is present in all regions. One of the major problems

Table 12.--Net cash rent to market value ratios for farm real estate by production regions 1961-1970

Region	Net rent as a percentage of market value									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Northeast----------	3.0	2.5	2.5	2.6	2.5	2.2	2.0	1.6	1.4	1.4
Lake States--------	4.3	4.1	4.1	4.2	4.3	4.2	4.2	4.0	3.8	3.7
Corn Belt----------	3.9	3.9	4.1	4.1	3.9	3.9	3.9	4.3	4.0	4.1
Northern Plains----	4.9	5.2	5.3	5.1	4.5	4.3	4.4	4.6	4.6	4.6
Appalachian--------	7.6	7.6	7.2	7.0	6.8	6.6	6.1	5.5	4.9	4.8
Southeast----------	6.4	6.1	5.9	5.9	6.3	6.1	5.3	4.3	3.9	3.7
Delta States-------	9.0	8.6	8.5	8.1	7.5	6.9	6.9	6.4	6.0	5.1
Southern Plains----	5.4	5.2	4.9	4.7	5.0	5.1	5.0	4.8	4.0	4.3
Mountain-----------	4.4	4.2	4.0	4.2	4.2	3.9	3.8	3.8	3.9	3.7
Pacific------------	4.0	3.7	2.9	2.6	2.4	2.2	2.2	2.2	2.0	1.7
48 States--------	4.6	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.5	3.1

Source: Farm Tenure and Cost Rents AER 190, ERS-USDA, August 1970.

in summarizing the influence of nonfarm factors on farmland values is that the sources of nonfarm demand vary greatly among areas and the relative impact of a particular nonfarm demand is not expected to be the same among regions or over time. For example, in Michigan the demand for rural residences and part-time farms may be a major factor influencing farm real estate values. However, in the Washington, D.C. area bedroom communities and recreational developments appear to dominate the nonfarm market for "farmland".

In other areas Federal flood control and recreation projects as well as highway development provide the stimulus for the nonfarm market while minerals and petroleum are important in others.

Observations from Previous Studies

Of the recent attempts to develop a model of the "national land market" 2 have included urban or nonfarm factors. Herdt and Cochrane attempted to represent urban demand for farmland by using an urban land quantity variable interpolated between census years. Reynolds, on the other hand, included several variables that attempted to use the relative earnings of farm and nonfarm people to measure urban influence. These included the percentage of farm operators working 100 or more days off the farm, personal income of the farm population fron nonfarm sources, the ratio of the personal income of the farm population to that of the nonfarm population and nonfarm population density.

In the Herdt and Cochrane study, the urban land quantity variable was highly correlated with their technology variable and because it was assumed to be the weaker of the two, it was deleted from the model. Thus, urban effects could not be separated from technological effects.

In the Reynolds model, none of the nonfarm influence variables appeared in the final time series model and population density was included in the cross sectional model but appeared to be nonsignificant. [38] The variables in the Reynolds model seem to be an attempt to measure the impact of direct competition between farm and nonfarm individuals for land for farm production. In addition, an attempt was made to measure the effect of different farm and urban income streams on the desire of farms to remain in agriculture. Only the nonfarm population density factor appeared to be a measure of the demand for farmland for urban uses.

As in many other studies, both the Herdt and Cochrane model and the Reynolds model treated the "farm real estate market" as a largely isolated market with almost no interaction from the urban or nonfarm sector or no impact from demands for land other than for the production of food and fiber.

Many other studies have, after rejecting the hypothesis that net income is a suitable proxy for returns to real estate, attempted to include other farm related variables to explain why land prices are increasing. If effect they seem to be searching for a reason for returns to land from farm production and, therefore, land prices to be increasing in the face of relatively constant net income to all factors on a per acre basis. At this point, conclusive evidence does not exist to determine the extent of urban or nonfarm influence on farm land price. We can only observe that farmland values tend to be higher in urban impacted counties than in more rural areas with similar land characteristics. We can also observe that where changes in land use are occurring rapidly land values tend to rise above the level supported by net land earnings from farm production. Until we can develop adequate measures of net real estate earnings from farm production, it seems unlikely that we can assess the impact of nonfarm demands on farmland values with any degree of certainly in the micro markets.

It may be that failure to accomplish this presents no real problem. However, when nonfarm factors compete strongly for particular tracts of land with highly specialized agricultural uses, we may find it desirable to know what the impact will be on society in general. For example, the loss of a few small areas in California could substantially change our ability to produce asparagus and certain other specialty crops. However, the loss of several thousand acres of cropland in the Northeast or Appalachian Regions may have almost no effect on the ability of the county to produce food and fiber. Thus, the impact of nonfarm demands and the degree of concern is largely a localized phenomenon and aggregate coefficient may have very little meaning.

A project is currently under way within the Farm Real Estate Group to classify farmland according to the degree of nonfarm influence. This classification system relies on population density and the percentage of the local population residing in urban areas as the major criteria for establishing urban impact areas. Only partial data is available for the year 1969; thus, the entire project cannot be summarized in this manuscript. However, the available data indicate that urban impacted areas experienced both a difference in the rate of increase in land values and a higher level of land values.

Conclusions

The critical question in farm--nonfarm competition for land involves the loss of certain scarce or critical lands from farm production. We as a nation do not need to fear the loss of sufficient land for grazing or grain production in the near future. However, we may find that certain tracts of land have such unique characteristics for the production of specialty crops that the loss of a few thousand acres may seriously impair our ability to produce the crop at a "reasonable price" to consumers. While unchecked urban growth may only marginally affect our ability to produce agricultural products, it may do irreparable harm to the environment and quality of life in particular markets. Our concern over urban competition for farmland may be natural concern over many localized problems.

CHAPTER IX

PREDICTIVE MODELS AND THE U.S. AVERAGE VALUE OF FARM REAL ESTATE

The preceding chapters have been directed at the evaluation of specific hypotheses offered in explanation of the steady rise in land values since 1940. The discussion has been directed at understanding the structure of land markets and the interrelationships among the variables which are frequently incorporated into various models of land markets.

In various places throughout the manuscript, the problems of specification and aggregation are encountered and discussed.

As yet, however, we have not been concerned with the construction of either a cross sectional or time series model that explained or predicted the value of real estate for a specific market or in the aggregate.

This chapter is devoted to the development of a model which predicts the national average value of farm real estate per acre. The model incorporates information from earlier chapters and yet, because it is an aggregate model, it does not directly incorporate the factors which are important in explaining land values at the local level.

The dependent variable (average value of Farm Real Estate per acre) is a summary statistic which is free of most of the variation caused by cross-sectional differences in land values. Thus, the remaining variance to be explained must be the result of those factors which have caused land values to change over time.

The remainder of this chapter is devoted to the rationale for the model and its development and use.

The model developed in this chapter is designed specifically to predict the average value of farm real estate at the national level. The ability to do so should provide a clearer picture of the wealth position of land owners. If we can improve our estimate of the value of real estate in the future, we should be able to improve our estimates of credit needs and total real estate debt.

Previous Models

Several models predicting the average value of farm real estate have been developed (22,30,38,53,54). However, for one reason or another, each model has become very complex. Reynolds relied heavily on recursive models to incorporate the results of simultaneous supply and demand equations. Tweeten and Martin have tested ordinary least squares, recursive least squares and autoregressive least squares. Each researcher or group of researchers has expressed a desire for a structurally correct model that efficiently predicts land prices in the national market.

In an attempt to build such models, many researchers have operated as though the U.S. average value represented a national market price of a homogenous commodity in an easily defined and isolated market with no alternative uses for the land except farm production. In fact, a national farm real estate market does not exist. Land prices are determined in isolated micro markets perhaps consisting of one or two farms or as much as several counties. Prices determined for spacially and productively different land with different utility attributes are aggregated and averaged to arrive at the national average value per acre.

The average value of farm real estate for the United States shows the net effect of all adjustment occurring in the farm and nonfarm sector that influences the value of farmland. If we could properly draw a sample across the U.S. and record for each observation the value per acre and the influence of specific factors on each acre in our sample, we should be able to explain the impact of various factors on the level of value between regions. And by observing changes in these factors in relation to specific tracts over time, we should be able to explain the effect of multiple factors over time. However, the cost of such a model would be fantastic and would no doubt overwhelm the benefits of such a procedure. Thus, researchers have attempted to develop less costly models that would provide some information on the structural characteristics and at the same time serve as useful predictors of the average value.

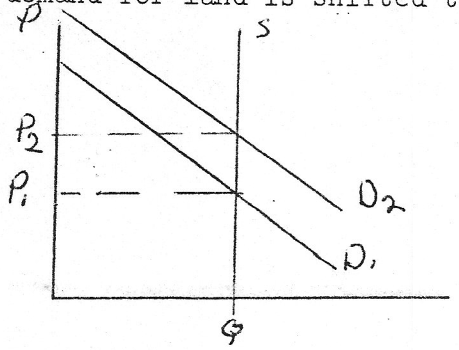
Because of the lack of data series for many variables, the use of proxy variables was necessary in many of the previously mentioned models. But, the reliability of the proxies was not seriously questioned and we were left wondering at the value of the coefficients derived from the model. An equally serious problem was that with as many as 10 to 20 variables in a model, the number of projections necessary for predicting the dependent variable made the end result subject to serious question.

Another serious problem with previous models was that they assumed that the national average value could adequately reflect the micro market variance in land values which could prove to be of minor national importance. However, the national average is a fairly smooth trend with much of the variance removed and, therefore, it is not sensitive to minor variations or disturbances coming from scattered real estate markets. In fact, the only variance left to explain is a modified yearly change in land values. Therefore, separation of this yearly change into the effects of four or more variables seem to imply too great a degree of precision in measurement of both the dependent and independent variables.

A Simplified Model

As an alternative to the deluge of econometrics we have been faced with in predicting the average value of farm real estate, a model is proposed in this chapter which is based on a few simple propositions. The model is easy to apply and is just as easily modified should we discover that it no longer holds because of basic shifts in the economy of the country. The variables included are highly aggregated and they can be criticized from several viewpoints.

Before proposing the model, let us consider the premises that are important to its construction. Economists are pretty well agreed that population is a primary shifter of demand functions. Most models of the real estate market have recognized that population is important in determining the demand for real estate and, therefore, in determining prices. Theory suggests that as population increases, other things equal, the price of land should increase as the aggregate demand for land is shifted to the right (fig. 1).



Given an inelastic supply of land, price will rise from p_1 to p_2. The demand shift occurs because of the increased need for space, food and fiber. In an economy where food and fiber needs of a growing population can be met from the existing agricultural plant or a smaller one, because of excess capacity that exists in agriculture, the primary factor causing land values to increase must be the demand for space for other economic and social activity.

If land used to produce food and fiber could be separated from the market for land as space, we would expect to see values for agricultural land rise only in response to the increased demand for food and fiber (largely from an increasing population) which would increase the MVP of land and other resources used in the production process. Land restricted to use as space for housing, recreation and other social activity would increase in value as the level of population increased, creating a demand for other land services.

Reverting to classical economics, given fixed production relationships and constant output, a change in the money supply will raise or lower prices proportionately in a competitive society with no money illusion. In a society with underemployment of resources, an increase in the money supply should shift demand for goods and services and call forth greater production. However, because we have a fixed quantity of land in the United States and because increases in the money supply cannot call forth the production of more land, the price of land must rise or fall in relation to the money supply, other things equal.

It is generally recognized that agriculture accounts for a very small segment of the general economy and that the demand for agricultural products is inelastic with respect to price and income. Thus, much of the increased demand comes from increasing population. Also, the farm population is declining while the nonfarm population has been increased dramatically. Because of the rapid increase of the nonfarm population, the demand for space for housing, recreation, power generation, waste disposal and environmental uses such as wildlife refuges and wilderness areas has increased.

In general we have enjoyed an excess capacity in agriculture which, in the absence of farm programs, would have caused a reduction in price for certain farm products and, therefore, a short-run decline in the demand for land for production purposes.

Since 1930 the United States has had an expressed policy of economic growth with nearly continuous increases in real GNP. Part of this growth policy has included a moderate degree of price inflation.

The concentration of an increasing percentage of an increasing population in metropolitan areas has not significantly reduced the individual demand for space. The effect has been to differentiate the market for space into several distinct categories such as housing, production, recreation and conservation and waste disposal. Thus, land that served multiple uses when the nation was predominately agricultural, is now compartmentalized into distinct single-use categories.

We have in this country already determined that the highest and best use of some land is recreational space or space to shelter game and birds. Until we revise our social preference and the desire to hold land as a public good, the price system will not function. We have also discussed the multiple uses rights of space and have moved toward separation of these rights through easements and leases. We have contemplated the purchase of production rights or development rights to control land use. Each of these ideas result from the multiple demands of a growing population for the inelastic and fixed supply of land.

We have, in fact, attempted to separate these markets for land through zoning, planning and taxation policies at the local and state level. At the national level we have designated specific areas as parks, wilderness areas, and wildlife refuges. We have not, however, decreed that land in agricultural use shall remain there in perpetuity; thus, the demands for space for other economic and social activity have had a pervasive influence on the value of farmland.

At some point (in the absence of further technological change and with an increasing population) we would expect the demand for food and fiber to become the primary concern of society. Therefore, agirculture would begin to encroach upon other uses of land as individuals in society reduced their nonfood space requirements in an effort to provide for their survival. Farm values would then, as in the past, be determined primarily by their agricultural productivity. On the other hand, with continuing technological changes which permit increases in productivity faster than the increase in demand for food and fiber and with increasing population, it would seem that a primary determinent of farm land values is the demand for land for nonfarm uses.

Given these propositions, we can see that the demand for space for food and fiber production has been supported by federal transfer of funds from the nonfarm sector while the demand for other uses has increased with the population. Thus, nonfarm demands for space for housing, recreation, production and environmental production have a pervasive influence on the value of a primary agricultural input.

If this hypothesis is accepted, it should be possible to construct a model explaining changes in the average value of real estate over time by using population and the money supply (or the ability of the population to acquire land).

We can assume that the total quantity of land is fixed and, therefore, the supply of land in total is not responsive to price. Increasing population will, therefore, exert an upward pressure on land values. Also, reverting to classical analysis, a change in the money supply will not affect the quantity of land and land prices will rise and fall with respect to changes in the money supply.

The model which I now propose relies on the foregoing propositions to explain the national upward trend in farm real estate values.

A basic assumption is that if a national land market exists it cannot be separated into farm and nonfarm segments that are isolated from one another and that the value of real estate as a farm input is largely determined by its value in competing uses.

If it were possible to decree that all land in farms would remain in farms in perpetuity, the only influence the nonfarm sector would have on its value would be from a change in demand for farm products. However, other demands for land are currently more important.

Given the foregoing assumptions, it seems plausible to specify

$L_V = f(P,M)$

Where L_V = the average value of farm real estate per acre

P = population in thousands

M = money supply including time deposits in hundred millions

Because a time series on the money supply including time deposits is not available before 1947, the model was tested using data from 1947 through 1970. The results of the ordinary least square model are as follows:

Variable	Regression coefficient	Standard error	T
P	.00086	.00009	10.14
M	.03141	.00199	15.81
Intercept	-109.84		
R^2	.998		

STD error of estimate 2.795

Durbin Watson statistic 1.04 with K = 2 df = 24

d_L= 1.06 d_U 1.42

Because the Durbin Watson test indicated that serial correlation was present, the data were transformed using a multiplier (r) developed according to the first order autoregressive scheme where

$$r = \frac{\sum_{t=2}^{n} \hat{U}_t \hat{U}_{t-1}}{\sum_{t=2}^{n} U^2_{t-1}}$$

and U_t = the residual in year t. The original data were transformed by $X_i' = Xi_{(t)} - rX_{i(t-1)}$ or

$$LV' = LV_t - .46457\ LV_{(t-1)}$$

$$P' = P_t - .46457\ P_{(t-1)}$$

$$M' + M_t - .46457\ M_{(t-1)}$$

Thus

$$LV' = f(P',M')$$

The results of the transformed data are:

Variable	Regression coefficient	Standard error of coefficient	T
Population	.00092	.00015	5.98
Money	.03048	100317	9.61

Intercept -63.267228

$R^2 = .994$

Standard error of estimate 2.527

Durbin Watson statistic 1.59

The intercept is an estimate of $\alpha(1-r)$

Therefore, it can be stated as

$$\frac{-63.267228}{.53549} = -118.15$$

and $LV_t = -118.15 + .00092P_t + .03048\ M_t$

There is no evidence of serial correlation in the transformed data and the standard error of the estimate is decreased slightly. Both regression coefficients remain highly significant.

There is, of course, a high degree of intercorrelation between the population series and the money supply; but this is to be expected in a growing economy. The separate effects of the explanatory variables may not be truly estimated, but for predictive purposes the model should perform reasonably well.

The results imply that a change in the population of one million would cause the national average value of farmland to change $.92 and a one billion dollar change in the money supply would change land values by $.30.

The model was tested for 1971 and 1972 using the following data.[1/]

Year	Population	Money supply
1971..........	207,006	418.2
1972..........	208,656	464.7

The resulting estimated values are compared with the observed values as follows.

Year	Observed	Estimated
1971..........	199	199.75
1972..........	215	215.45

[1/] Since the development of the model, the data on the average value of farm real estate has been revised upward slightly (about $2 per acre) from 1965 through 1972. Also, data on the money supply have been revised. It would be desirable to recalculate the regression coefficient to account for these changes. However, the differences are expected to be slight.

An alternative definition of the money supply using only demand deposits and currency produced doubled the standard error of the estimate. The result from the second model was anticipated because time deposits represent the ability of the economy to make long-term investments while currency and demand deposits reflect the transaction demand for goods and services.

The second model, which included population demand deposits and currency, was tested from 1930 through 1959 and for this time series produced an R^2 of .96. This model proved to be the least reliable from 1930 through 1938. If data were available on time deposits for this period, it is expected that a better fit could be achieved.

Comments on the Specification of the Model

Many of my coworkers have pointed out that many time series on aggregate data from 1947 to 1970 could have produced a very high R^2. They have also suggested that the model cannot be a proper specification because it does not directly include technology, net income, or farm programs.

If the dependent variable included observation on individual tracts of land or observations for specific markets over time, it might be possible to separate the effects of numerous factors on land markets. However, the dependent variable is a weighted average of all land in the United States; as such, the variance associated with land quality, differences in production patterns, differences in net income, different levels of program payments and shift in population are hidden by the weighting procedure. The variance remaining in the average is the net change over time from all factors in the land market.

At the market level money variables seem to explain land price and may be necessary to determine the value of a particular tract of land because farmer Brown must rely on his income to pay for the land he buys. However, his income increasingly includes nonfarm income and part of the demand he expresses for land is a demand for nonfarm services. He is in competition with other individuals with similar motivations and must translate his desire into a market price.

Because land is non-reproducible, the individual acquires land at whatever the market price is and organizes his other inputs in a manner that will yield the highest return or the lowest cost given the price of land. Admittedly in some areas, the primary factor establishing the price of land is its value in farm production; in other areas, nonfarm factors overwhelm the value based on farm earnings. However, changes in the national average value can best be explained by those factors that shift the national demand for land.

If one were to explain the average price of all vegetables, for whatever reason, you would not expect the factors which are common only to lettuce to be very closely related to the changes occurring in the average for all vegetables. A more appropriate model might specify those factors that were common to all vegetables determining the changes occurring in the average price of all vegetables over time.

Perhaps a better analogy would be the average price of a pound of carbohydrates. If we wished to predict the average price of all carbohydrates given a fixed supply, we might choose population and income or the money supply. We would not likely be concerned about those factors which were specific to wheat, oats, or potatoes. The general average price of carbohydrates could be rising because of an increase in population, yet the relative price of oats, wheat and potatoes might remain about the same so long as no change in tastes and preference occurred or the relative price might be changing drastically.

The most important factors in the demand for farmland are the shifts caused by an increasing population's demands for land for all uses and the effect of changes in the medium of exchange to acquire that land.

If we can accept that we have a national policy of growth, and that an increased supply of money is consistent with growth, that there are few good substitutes for space, and that population will continue to increase, then our long-run expectation is that the level of land values will rise.

If there is a need to predict the average value of farm real estate, for example, to arrive at a total value of the capital stock or the monetary wealth of land owners, then this model should perform more "efficiently" than more complex econometric models which require a larger number of assumptions and more proxy variables. If we can project population and the money supply, we should be able to arrive at a fair approximation of the average level of land values.

The model developed in this chapter is an aggregate model and it cannot be used to explain differences in land value trends among regions, states, or micro market areas.

This, however, does not present a serious problem since no model constructed nationally can be expected to perform equally well in all regions or markets and certainly regression coefficients developed nationally should not be expected to accurately predict land values in a local area.

Nonfarm factors play a much larger role in New England for example than they do in North Dakota, while income from wheat production in North Dakota is more important than nonfarm factors.

Summary

The complex multi-equation models developed to explain the national average value of farmland have, in general, been formulated from economic theory and analysis that explains cross sectional variation in land prices. They have assumed a great deal about the precision with which the national average value was measured and, in general, have been applications of rather complex and sophisticated tools to a rather crude measure of the trend in real estate prices. Any attempt to separate the effects of 5 or 6 variables in a crudely approximated and fairly smooth trend that already has much of the variance removed seems to stretch the data too far. And it is not too surprising that some of the coefficients in the complex models turn out nonsignificant or with an unexpected sign.

The model developed in this chapter attempts to draw on those factors which appear to strongly influence the national trend. It draws together the impact of other variables into two factors, population and the money supply. The money supply, in a sense, represents the inflationary trend in the economy as the supply of money increases relative to the supply of land and of other goods and services.

The model developed here has a foundation on economic theory and appears to give satisfactory results in reproducing an historical series. Whether or not it proves satisfactory in predicting land values is yet to be determined.

CHAPTER X

SUMMARY AND CONCLUSIONS

The national average value of farm real estate has increased rapidly over the last 3 decades, and analysts of real estate prices have observed an apparent divergence between the rate of increase in real estate values and the rate of increase in net farm income per acre. This divergence led to the formation of several hypotheses that were offered in explanation of this divergence. A basic premise of these hypotheses was that net income per acre was a suitable proxy for land earnings; and, since farmland value should be dependent on earnings, net income and land value should move in parallel trends.

The basic objectives of this study were to explore the several hypotheses offered in explanation of the dramatic rise in real estate prices and determine which of these seem to have merit in terms of current economic conditions.

A review of the literature on farm real estate revealed that several hypotheses predominated over all others as explanations of the divergence in trend between income and land values. However, a considerable difference of opinion continued to exist over the importance of certain variables and direction of influence.

The review also revealed that most national studies and models of the "real estate market" were composed of complex formulations which included both cross-sectional and time series data. Most of the times series studies and several of the cross-sectional studies encountered severe problems with intercorrelation and also suffered from a lack of suitable data which forced the use of some rather dubious proxies.

Of the several hypotheses offered as explanation of national average land price changes by previous studies and by conventional wisdom, 8 were selected for more detailed examination in this manuscript. These 8 were selected because of the prominence they had received or because there seemed to be a theoretical basis for the linkage between the variable and land prices. Included were capital appreciation, technological change, farm commodity programs, enlargement demand, seller financing, nonfarm factors, population, and general economic inflation.

Annual appreciation in values seems to be of rather minor importance as a factor in the income stream of land buyers. Appreciation would be expected to be most important in those areas that are undergoing a rapid change in use such as the rural-urban fringe and least important in the more rural areas. Because appreciation is the result of a price change, it is determined by the same factors that influence price. Therefore, any model which incorporates appreciation is somewhat circular since price expectations are based on previous price changes rather than on earnings. In any event, unless a shift in use or a change in income occurs, price expectations based on continued appreciation may be largely an illusion.

Although technological change may have been important in changing the allocation of returns among resources, the evidence seems less than conclusive with respect to its impact on land values. Static analysis seems to show that the impact of changing technology on land values should be negative. However, what we view as a farm enlargement demand may be largely the result of changes in technology which shift the optimum size of farm.

In addition, what may have been viewed as technological advance to the firm may have resulted in externalities which were borne by other sectors of the economy.

Farm programs have undoubtedly had an impact on land values; however, their impact has been quite different depending on the crop production patterns of the area and the nonfarm alternatives available for capital and labor. Nationally such programs represented 8 percent of the total value of real estate in 1970, and it is unlikely that they ever amounted to a higher percentage than this over their 38-year history. By states, capitalized values for programs range from less than 1 percent in Maine to 33 percent in North Carolina.

Farm enlargement demand resulting from an upward shift in the optimum size of farm appears to be responsible for much of the demand existing in major farming areas, but farm enlargement demand cannot be the impact of technological change on farm programs. It is doubtful if these factors can be captured in a single variable because the quantity of land demand for enlargement is a function of changes in technology constrained by changes in program benefits. We should also be aware that the supply of tracts offered for sale are generally less than the optimum size of farm; therefore, what appears as an overwhelming demand for enlargement tracts may be a response to a market that offers only enlargement tracts for sale.

Seller financing added to the rate of increase in real estate prices in the last decade as lower interest charges were capitalized into the value of land. Changes in the percentage of seller financing and in the relative difference between mortgage and land contract rates of interest may have inflated land values nationally by 5 percent from 1964 to 1970. If credit markets stabilize at about the present proportion of contract lending to commercial lending, no further change in the rate of land value increase would be expected.

Nonfarm factors affect the farm real estate market through direct urbanization, recreation, wildlife conservation, waste management and through the nonfarm demands of farm people. A few areas are relatively free of this impact. In other areas the nonfarm market may be the basic determinant of value.

Each of the factors mentioned above appears to contain a great degree of cross-sectional variation because of the differing relative importance of the factor in local land markets. If, in fact, land values are a function of the factors considered, estimates of the coefficients for these factors would be expected to differ greatly among regions. For example, nonfarm pressure would be expected to explain most of the change in land values in the northeast while farm enlargement and farm programs would be most important in North Dakota.

Such differences among regions tend to be averaged out in the national average value, and the change in the national average should tend to reflect the impact of global land demand and supply shifters. Since the aggregate quantity of land is fixed for the U.S., we chose variables for our aggregate model which seemed to be basic demand shifters and which included both the farm and nonfarm demands for land. Thus, the upward trend in land price was hypothesized to be a function of population and the money supply (including time deposits).

Both variables were found to be highly significant in the regression model, and the percentage of variance explained was extremely high. In addition, when the model was used to estimate the value for the 2 succeeding years, the estimated value was within 50 cents (1/4 of 1 percent) of the observed average.

Conclusions

The major conclusions of the study are that farm and nonfarm real estate markets are inseparable and that the demand for farmland rises basicly from the nonfarm population's desire for food and land. In addition, as long as population and the money supply continue to increase, the price of farmland will continue to rise in the absence of rather dramatic technological changes and in the absence of a real shift in the tastes and preferences of individuals.

As individuals spend less time in production activities and as their incomes increase, it is likely that land will become a greater factor in their preference function, and its scarcity will be increased relative to the current situation. Even if we move toward zero population growth, the pressure on land will be dramatic over the next 70 years (the projected time that zero growth will be achieved).

It seems that, in the aggregate, the population and money supply model may perform well over some extended period of time. At the market level the differences in importance of factors will continue and adequate predictive measures may be difficult to develop. Regression analyses may provide some assistance to local appraisers and assessors, yet the sources of variation are many and the number of observations available for analysis are quite small; thus, collection of sufficient data for analysis may be impossible at a reasonable cost. Farm real estate is a heterogeneous commodity and collection of sufficient data to remove the variation present in location and quality reduces our ability to do adequate time series analyses.

Relevant considerations for policy decisions would seem to include the possibility of segregating farm real estate from urban land if the level of prices is to be kept in line with farm earnings. Also, consideration should be given to alternative methods of supporting the income of farm people to avoid retarding resource adjustments and modification of capital values.

We should be developing a rational land use policy for the nation recognizing that a continuous policy of economic growth will greatly affect the holder of land and the ability of others to acquire it. Our preoccupation with the farm sector in past exploration of farm real estate price trends has focused our attention too narrowly, and we must recognize the great interdependence of the farm and non-farm sectors of the economy.

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